O & M Manual

SOIL VAPOR EXTRACTION (SVE) OPERABLE UNIT DRAFT OPERATIONS AND MAINTENANCE MANUAL

PHOENIX-GOODYEAR AIRPORT (SOUTH), POLYGONS 96/92/27A, GOODYEAR, ARIZONA

SUBMITTED TO:

GOODYEAR

THE GOODYEAR TIRE & RUBBER COMPANY
AKRON, OHIO

Polygon 79 Draft: August 4, 1993
(Polygon 79 Revised: November 5, 1993)
(Polygon 84 Update: August 5, 1994)
(Polygons 96/92/27A Update: December 22, 1995)

PREPARED BY:

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An Air and Water Technologies Company
701 B Street, Suite 1100
San Diego, CA 92101

INSTRUCTIONS FOR UPDATING SVE OPERABLE UNIT OPERATIONS AND MAINTENANCE MANUAL FOR POLYGON 96/92/27A

The attached draft addendum pages (printed on tan paper) should be incorporated into the final Polygon 79 O&M Manual entitled, "Soil Vapor Extraction (SVE) Operable Unit Final Operation and Maintenance Manual; Pheonix-Goodyear Airport (South), Polygon 79, Goodyear, Arizona," updated August 5, 1994 for Polygon 84, in accordance with the instructions outlined in the table below. These pages are provided to update the manual for operations at Polygons 96/92/27A. Appendix sections are separated by blue paper which can be recycled or otherwise discarded.

All pages removed from the Polygon 79/84 Manual should be archived in the binder provided.

Section	Remove pages from Polygon 79/84 Manual:	Replace with Polygon 96/92/27A Pages:
Outside Cover	yes	yes
Cover Letter	8/5/94 letter	12/22/95 letter
Inside Cover	1 sheet	1 sheet
TOC	I to V	I to V
Introduction	i to xix	i to xxii
1.0	1-1 to 1-6	1-1 to 1-7
2.0	2-1 to 2-8	2-1 to 2-8
3.0	3-1 to 3-11	3-1 to 3-11
4.0	4-1 to 4-10	4-1 to 4-10
5.0	5-1	5-1
6.0	6-1 to 6-24	6-1 to 6-26
7.0	7-1 to 7-15	7-1 to 7-17
8.0	8-1 to 8-2	8-1 to 8-2
9.0	9-1 to 9-3	9-1 to 9-2
Appendix A	All pages	23 sheets (11"x17")
Appendix B	Section 5 Cover Sheet	Section 5 Cover Sheet
Appendix C	All Pages	New Appendix C
Appendix D	D-18,D-36,D-38,D-39,D-46	D-18,D-36,D-38,D-39,D-46
Appendix E	None	None
Appendix F	All Pages	New Appendix F
Appendix G	None	None
Appendix H	All Pages	New Appendix H

Metcalf & Eddy
An Air & Water Technologies Company

J 017761.0003

December 22, 1995

Ms. Nancy Moore
Arizona Department of Environmental Quality
3033 North Central Avenue
Phoenix, Arizona 85012

Subject: SVE Draft Operation & Maintenance Manual Update
Polygons 96/92/27A, Phoenix-Goodyear Airport Site
Goodyear, Arizona

Dear Ms. Moore:

Enclosed please find the Draft Soil Vapor Extraction (SVE) Operation & Maintenance Manual for Polygons 96/92/27A. This report is submitted on behalf of The Goodyear Tire & Rubber Company in accordance with requirements of the 1992 U.S. EPA Consent Decree (Section VIII, D-8). This document fulfills the tasks in the Consent Decree, as well as fulfilling the tasks outlined in the U.S. EPA-approved SVE Final Design for Polygons 96/92/27A dated June 1, 1995.

This Draft Operations & Maintenance Manual is an update (Draft O&M Update) to the U.S. EPA-approved Polygon 79 Final Operations & Maintenance Manual dated November 5, 1993. The Draft O&M Update details the methods of SVE operation compliance with Section VII.D.15 of the Consent Decree and highlights the operation and maintenance of the treatment system components, the extraction wells, and monitoring wells for Polygons 96/92/27A. The document also details the sampling and VLEACH modeling for sub-area and polygon closure.

The primary modifications that have been made to the November 5, 1993 Polygon 79 O&M Manual are the parameters that pertain to system operations specific to Polygons 96/92/27A. These parameters include the number of extraction and monitoring wells to treat and monitor the remediation progress in each polygon and operation priorities. In an effort to make agency and field personnel referencing easy, all pages pertaining to the Polygon 96/92/27A update are printed on ***tan*** paper. It should be noted that the November 5, 1993 Polygon 79 O&M Manual was modified on August 5, 1994 for Polygon 84 SVE system and sub-area operations. These modifications were printed on ***green*** paper for easy reference. Where no changes to the August 5, 1994 Polygon 84 O&M Manual update have been made by this modification, the ***green*** pages shall remain in the O&M Manual and are considered the most recent and up to date information. Instructions have been provided with this package to update your August 5, 1994 Polygon 84 O&M Manual. The removed green pages and old covers can then be inserted into the provided binder for archiving.

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Since the operational, monitoring and modeling criteria for Polygons 96/92/27A remain the same as Polygon 79, Goodyear anticipates that U.S. EPA will promptly approve this Draft O&M Update and will authorize SVE system start-up in accordance with the 1992 Consent Decree (VI, D-13). Once the SVE system has been started, Goodyear will submit a revision of this Draft O&M Update as the Final Polygon 96/92/27A O&M Manual in accordance with the Consent Decree (VII,D-14). As with Polygons 79 and 84, operational data will be submitted as part of the PGA monthly report to U.S. EPA.

Pursuant to your review and approval of this report, Goodyear anticipates start-up of the SVE system in late January 1996.

If you have any questions regarding this document or any other site issues, do not hesitate to contact me at (619) 233-7855.

Sincerely,

Scott P. Zachary
Project Manager
Metcalf & Eddy, Inc.

KAW:cw
Enclosures

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SOIL VAPOR EXTRACTION (SVE)
OPERABLE UNIT DRAFT
OPERATIONS AND MAINTENANCE
MANUAL

PHOENIX - GOODYEAR AIRPORT (SOUTH), POLYGONS 96/92/27A, GOODYEAR, ARIZONA

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SVE OPERABLE UNIT OPERATION & MAINTENANCE MANUAL

INTRODUCTION

This Draft Soil Vapor Extraction (SVE) Operable Unit Operation and Maintenance (O&M) Manual has been developed for an off-site regeneration carbon treatment system. The Draft SVE O&M Manual dated August 4, 1993 was approved by the U.S. EPA on September 2, 1993 with comment. The Final SVE O&M Manual for Polygon 79, dated November 4, 1993, incorporated U.S. EPA's comments to satisfy the 1990 Consent Decree, Section VII report submittal requirement under Subsection D. 14, p. 22. The Final SVE Polygon 79 O&M Manual was updated for Polygon 84 operations by an addendum dated August 5, 1994. Pages revised on the Polygon 84 Update are indicated by green pages in this manual.

The Final SVE Polygon 79 O&M Manual with revisions for Polygon 84 has been updated for SVE operations at Polygons 96/92/27A by addendum. This draft addendum includes portions of the O&M Manual text which have been revised to reflect conditions at Polygons 96/92/27A. Addendum pages which reflect changes for Polygons 96/92/27A are indicated by ***tan*** pages in this manual.

This O&M Manual is organized to provide the user with readily available information on the equipment, operation and operating philosophy (based on the EPA Consent Decree document of 1987) of the SVE system. Sections 1 through 4 of this document detail the Operation and Maintenance of the SVE treatment system components and Sections 5 through 7 detail the extraction well operation for each polygon and sub-area, including rebound and monitoring.

In this O&M Manual, reference to equipment components is made generally in the order in which soil vapors come into contact with the equipment, upstream to downstream. Due to the number of equipment suppliers and different organizations involved with the fabrication of components and systems, nomenclature for some components and systems may vary somewhat. The system Process and Instrumentation Diagrams (P&IDs) at the end of this section and detailed manufacturer's literature provided in this manual should clarify any questions on nomenclature.

The SVE system operation, maintenance, and monitoring will be coordinated among several parties. With the remote telemetry system, many of the monitoring and data collection activities can be run remotely without the need for on-site technicians. The planned responsibilities are listed in Table i-1.

With the remote system, M&E can collect data on the system. A telemetry link will also be provided to the local (Phoenix) technician for system status and response to alarm conditions. M&E will be consulted regarding alarm conditions and the appropriate response will be initiated. Both parties will have the capability of remotely shutting down the system should an alarm or emergency condition exist (see Appendix F, Emergency Contingency Plan). This allows the system to be run remotely and the data to be collected by the same party that is conducting the data evaluation. Additionally, the collected data will be able to be compiled and analyzed in a timely manner for incorporation into Goodyear's monthly report to U.S. EPA.

The SVE system consists of five major system components. These are: (1) Extraction Wells and Piping, (2) Vapor Inlet System, (3) Vapor Treatment System, (4) Vacuum Extraction Module, and (5) Electrical Control System and Power Distribution Module. Each of these major components is comprised of hardware from various suppliers. Some of the hardware requires no maintenance and no instructions to operate. The components which do require routine servicing, maintenance or instructions to operate safely and effectively are discussed in this O&M manual.

Weekly inspections are to be performed as part of routine system operation. Prior to shutdown for carbon changeout or other minor, short-duration shutdowns, a weekly inspection form should be completed. Instrument readings should be recorded prior to shutdown and after restart. The inlet header block valve, BV-1 should be closed during shutdown and opened completely prior to restart. Table i-2 provides a weekly monitoring form for inspection documentation.

Monthly inspections should include a complete system visual inspection, including general appearance and condition of paint and protective coatings. Condensate handling components should be inspected for leaks and drips. Blower oil should be changed monthly, more frequently if deemed necessary

TABLE i-1
SOIL VAPOR EXTRACTION OPERATION & MAINTENANCE RESPONSIBILITIES

Activity	Group Responsible
System start-up	M&E
Remote monitoring	M&E
Emergency response for system alarm	Local technician
Routine Calibration of PID	Local technician
Respond to calls from M&E on system adjustments	Local technician
Data download/analysis/archiving (e.g. VLEACH & Mixing Cell, radius of influence, well efficiency, vapor flow modeling, treatment system emission reporting)	M&E
System adjustments	Local technician following instruction from M&E
Carbon replacement	Carbon vendor following breakthrough with local technician oversight
System maintenance and security	Local technician
Rebound monitoring	M&E
Laboratory sample collection	M&E
Chemical analysis (field GC, analysis TO - 14)	M&E and CLP laboratory

Table i-2
SVE OPERABLE UNIT WEEKLY MAINTENANCE CHECKLIST

Date: ___/___/___ Time: Begin ______ End ______ Name ________________________

Wind: Spd ____ Dir ____ Temp ____F Cloud ____ Ppt(last 72 hrs) _____ Other ______

P&ID DESIGNATION	NAME/DESCRIPTION	ACTIVITY	CONDITION/VALUE
PF-44	Pitot Flow Indicator - Inlet Header	Reading	D. Press
BV-1	Inlet Air Block Valve	Position	Open/Closed
BFV-1	Dilution Air Station Blending Butterfly Valve	Position	
PI-02/PI-09/PI-13	Vacuum Gauges	Reading	Hg
DPI-23	Differential Pressure Gauge	Reading	"H_2O
FI-01	Differential Pressure (Flow) Gauge	Reading	scfm
TE-15/TI-15	Thermowell and Thermometer	Reading	F
FI-14	Differential Pressure (Flow) Gauge	Reading	scfm
DPI-22	Differential Pressure Gauge	Reading	"H_2O
TE-17/TT-17/TI-17	Model 2800 Temperature Transmitter & Gauge	Reading	F
PI-16	Vacuum Gauge	Reading	Hg
PI-20	Pressure Gauge	Reading	psi
TSHH-21/TI-21	Temperature Switch/Gauge	Reading	F
AE-1/AE-11	Hydrocarbon Analyzer	Clean Lamp/Calibrate	
CLEAN-OUTS	Piping Components / Clean-outs	Visual Inspection	Free of condensate and debris
LG-03	Vapor/Water Separator Liquid Level Indicator	Reading	Liquid level to remain above low level on site glass
VS-41	Primary Carbon Inlet Vapor Sample	Sample/Reading	ppmV
VS-42	Secondary Carbon Inlet Vapor Sample	Sample/Reading	ppmV
VS-43	Secondary Carbon Outlet Vapor Sample	Sample/Reading	ppmV
VS-45	Wellfield Influent Vapor Sample	Sample/Reading	ppmV

per manufacturer's instructions. Extended shutdowns for repairs or rebound testing lasting more than two weeks should be accompanied by a monthly inspection form upon system restart.

An oil change is not necessary if the total hours of operation at the next scheduled monthly maintenance do not exceed 1,000 hours. The inlet header block valve, BV-1, the air bleeding valve, BFV-1, and all extraction well valves should be closed during shutdown and opened completely prior to restart. Table i-3 provides a monthly monitoring form for inspection documentation.

Once per year, or upon relocating the system, a rigorous annual inspection should be performed. Blower guard covers should be removed and moving parts inspected. Blower drive belts should be inspected and replaced if worn. Filters should be opened and inspected. The overall system condition should be thoroughly examined annually. An oil change is not necessary if the total hours of operation at the next scheduled monthly maintenance do not exceed 1,000 hours. The inlet header block valve, BV-1 and all extraction well valves should be closed during shutdown. Tables i-4 and i-5 provide annual monitoring forms for inspection documentation.

Non-routine inspection and maintenance should be conducted whenever operating conditions indicate the need. Specifically, when differential pressure readings across particulate filters increase, filters should be opened and inspected for pluggage. Other indicators of system trouble, such as high exhaust temperature, high electrical current usage, or excessive vacuum or pressure should be reviewed and appropriate action taken.

It is intended that the user reference the manufacturer's literature, provided in Appendix B, the American Filtration Systems (AFS) Operating Manual. Table i-6 lists the hardware for each major system component, their designation on the project P&IDs, manufacturer and the manufacturer's telephone number. Table i-7 is the SVE Valve List. To facilitate equipment and functional references, the two part P&ID, Figures 96-E-2 and 96-E-3, and Drawings are included in this introductory section. Table i-8 briefly lists the system functions as called out in Figures 96-E-2 and 96-E-3, provided at the end of this section and in Appendix C.

The following sections describe the major components of the SVE operable unit and its normal operation and maintenance components.

Table i-3
SVE OPERABLE UNIT MONTHLY MAINTENANCE CHECKLIST

Date: ___/___/___ Time: Begin _____ End _____ Name_______________

Wind: Spd ____ Dir ____ Temp ____F Cloud ____ Ppt(last 72 hrs) _____

P&ID DESIGNATION	NAME/DESCRIPTION	ACTIVITY	CONDITION/VALUE
VAPOR EXTRACTION WELL PIPING COMPONENTS		Visual Inspection	
VALVES AND FITTINGS		Position	Percent Open/Closed
HBV-92W	Header Butterfly Valve, Polygon 79 Wells	Position	Open/Closed
HBV-92N	Header Butterfly Valve, Polygon 84 Wells	Position	Open/Closed
PF-44	Pitot Flow Indicator	Reading	D. Press
BV-1	Inlet Air Block Valve	Position	Open/Closed
BFV-1	Dilution Air Station Blending Butterfly Valve	Position	
VAPOR/LIQUID SEPARATOR	Vapor/Liquid Separator	Visual Inspection; Leak Check	
LIQUID STORAGE TANK	240 Gallon Condensed Liquid Storage	Visual Inspection; Leak Check	
JUNCTION BOX	Level Switch and Pump Motor Class I Electrical Junction Box	Visual Inspection	
FE-01/FE-07/FE25	Differential Pressure Flow Sensors	Visual Inspection, Clogs & Blockage	Clean/Dirty/Stained
FILTER/SILENCER	Dilution Air Filter/Silencer	Visual Inspection	Clean/Dirty
PI-02/PI-09/PI-13	Vacuum Gauges	Reading	Hg
BASKET STRAINER	Basket Strainer	Visual Inspection; Leak Check	Clean/Dirty
P-1	Separator Drain Pump and Motor	Visual Inspection; Leak Check	Clean/Dirty
DPI-23	Differential Pressure Gauge	Reading	"H_2O

P&ID DESIGNATION	NAME/DESCRIPTION	ACTIVITY	CONDITION/VALUE
FI-01	Differential Pressure (Flow) Gauge	Reading	scfm
TE-15/TI-15	Thermowell and Thermometer	Reading	F
CARBON CANISTERS	Carbon Canisters and Hoses	Visual Inspection	Clean/Rust
CARBON	Granular Activated Carbon	Visual Inspection	
EXTRACTION BLOWER	50 HP Extraction Blower	Visual Inspection	Change Oil Belts - OK/Loose/Worn
FE-14	Differential Pressure (Flow) Sensor	Visual Inspection	
FI-14	Differential Pressure (Flow) Gauge	Reading	scfm
DPI-22	Differential Pressure Gauge	Reading	"H_2O
TE-17/TT-17/TI-17	Model 2800 Temperature Transmitter & Gauge	Reading	F
PSV-18	Vacuum Relief Valve	Visual Inspection	
PI-16	Vacuum Gauge	Reading	Hg
EXPANSION JOINTS	Expansion Joints	Visual Inspection	
PI-20	Pressure Gauge	Reading	psi
TSHH-21/TI-21	Temperature Switch/Gauge	Reading	F
DISCHARGE SILENCER	Discharge Silencer	Visual Inspection	
TELEMETRY / CONTROL SYSTEM AND AUTODIALER	Telemetry Control System Including Central Computer System, Remote Terminal Unit and Cabinet	Visual Inspection / Test	
AE-1/AE-11	Hydrocarbon Analyzer	Calibrate/Clean Lamp and Filters	
POWER DISTRIBUTION MODULE	Power Distribution Module Including Circuit Breakers, Power Block, Motor Starters, Transformer and Lighting Panel	Visual Inspection, Test Breakers	

P&ID DESIGNATION	NAME/DESCRIPTION	ACTIVITY	CONDITION/VALUE
CLEAN-OUTS	Piping Components / Clean-outs	Visual Inspection	Free of condensate and debris
LG-03	Vapor/Water Separator Liquid Level Indicator	Reading Flush Separator and Piping with Clean Water	Liquid level to remain above low level on site glass

Table i-4
SVE OPERABLE UNIT ANNUAL MAINTENANCE CHECKLIST

Date: ___/___/___ Time: Begin ______ End ______ Name________________

Wind: Spd ____ Dir ____ Temp ____F Cloud ____ Ppt(last 72 hrs) _____

P&ID DESIGNATION	NAME/DESCRIPTION	ACTIVITY	CONDITION/VALUE
VAPOR EXTRACTION WELL PIPING COMPONENTS	Piping	Visual Inspection	
ROADWAY VAULTS	Roadway Vaults	Visual Inspection	
VALVES AND FITTINGS	Valves and Fittings	Position/Visual Inspection/Leak Test	Percent Open/Closed
HBV-92W	Header Butterfly Valve, Polygon 79 Wells	Position/Leak Test	Open/Closed
HBV-92N	Header Butterfly Valve, Polygon 84 Wells	Position/Leak Test	Open/Closed
PF-44	Pitot Flow Indicator	Reading/Clean	
BV-1	Inlet Air Block Valve	Position/Leak Test	Open/Closed
BFV-1	Dilution Air Station Blending Butterfly Valve	Position/Leak Test	
VAPOR/LIQUID SEPARATOR	Vapor/Liquid Separator	Visual Inspection, Leak Check/Flush with Clean Water	
LIQUID STORAGE TANK	240 Gallon Condensed Liquid Storage	Visual Inspection, Leak Check/Flush with Clean Water	
JUNCTION BOX	Level Switch and Pump Motor Class I Electrical Junction Box	Visual Inspection	
FE-01/FE-07/FE25	Differential Pressure Flow Sensors	Visual Inspection, Clogs & Blockage	Clean/Dirty/Stained
FT-07	Differential Pressure (Flow) Transmitter	Visual Inspection	
FILTER/SILENCER	Dilution Air Filter/Silencer	Visual Inspection / Replace	Clean/Dirty
PI-02/PI-09/PI-13	Vacuum Gauges	Reading	Hg
LSL-3/LSH-3/LSHH-3/LSHH-5	Liquid Level Controls with Electronic Switches	Visual Inspection	

P&ID DESIGNATION	NAME/DESCRIPTION	ACTIVITY	CONDITION/VALUE
BASKET STRAINER	Basket Strainer	Visual Inspection, Leak Check/Clean	Clean/Dirty
P-1	Separator Drain Pump and Motor	Visual Inspection, Leak Check/Clean / Flush	Clean/Dirty
CSL-375P-600F	Inline Particulate Filter	Visual Inspection / Replace	Clean/Dirty
DPI-23	Differential Pressure Gauge	Reading	"H_2O
FSL-01/FE-01	Differential Pressure (Flow) Switch	Visual Inspection / Test	
FI-01	Differential Pressure (Flow) Gauge	Reading	scfm
TE-15/TI-15	Thermowell and Thermometer	Reading	F
CARBON CANISTERS	Carbon Canisters	Visual Inspection	Clean/Rust
CARBON	Granular Activated Carbon	Visual Inspection	
SOUND ENCLOSURE AND SKID	Sound Attenuated Extraction Blower Enclosure and Frame	Visual Inspection / Loose Bolts/Cracks	
EXTRACTION BLOWER	50 HP Extraction Blower	Visual Inspection, remove guards and check moving parts	Change Oil Belts - OK/Loose/Worn/Dress
FE-14	Differential Pressure (Flow) Sensor	Visual Inspection / Clean	
FI-14	Differential Pressure (Flow) Gauge	Reading	scfm
CSL-375P-600F	Inline Particulate Filter	Visual Inspection / Replace	Clean/Dirty
DPI-22	Differential Pressure Gauge	Reading	"H_2O
TE-17/TT-17/TI-17	Model 2800 Temperature Transmitter & Gauge	Reading	F
PSV-18	Vacuum Relief Valve	Visual Inspection	
PI-16	Vacuum Gauge	Reading	Hg
EXPANSION JOINTS	Expansion Joints	Visual Inspection	
PI-20	Pressure Gauge	Reading	psi
TSHH-21/TI-21	Temperature Switch/Gauge	Reading	F

P&ID DESIGNATION	NAME/DESCRIPTION	ACTIVITY	CONDITION/VALUE
DISCHARGE SILENCER	Discharge Silencer	Visual Inspection	
TELEMETRY / CONTROL SYSTEM / AUTODIALER	Telemetry Control System Including Central Computer System, Remote Terminal Unit and Cabinet	Visual Inspection / Test	
AE-1/AE-11	Hydrocarbon Analyzer	Calibrate/Clean	
POWER DISTRIBUTION MODULE	Power Distribution Module Including Circuit Breakers, Power Block, Motor Starters, Transformer and Lighting Panel	Visual Inspection / Clean/Test Breakers	
CLEAN-OUTS	Piping Components / Clean-outs	Visual Inspection / Clean	Free of condensate and debris
LG-03	Vapor/Water Separator Liquid Level Indicator	Reading/Clean	Liquid level to remain above low level on site glass

Table i-5
ANNUAL SVE VALVE INSPECTION LIST

VALVE IDENTIFICATION	DESCRIPTION	VISUAL INSPECTION COMMENTS
BV-1	Inlet header manual block valve, PVC	
BV-2	Vapor/Liquid separator manual water shut off block ball valve, PVC	
BV-3	Pump (P-1) manual water shut off block ball valve, PVC	
BV-4	Condensate tank drain manual water shut off block ball valve, PVC	
BV-5	Stack sump water drain manual gate block valve, cast	
BFV-1	Air blending station manual butterfly valve, PVC	
CV-1	Inlet header isolation spring (automatic) check valve, steel	
CV-2	In-line automatic pump (P-1) backflow prevention check valve	
HBV-92W	Header Butterfly Valve, Polygon 79 Wells	
HBV-92N	Header Butterfly Valve, Polygon 84 Wells	
PRV-1	Automatic pressure relief valve for GAC-1, cast	
PRV-2	Automatic pressure relief valve for GAC-2, cast	
R-1	Blower recirculation manual gate valve, bronze	
WV-92-1	Vapor extraction well (VEW-92-1) manual flow control ball valve, PVC	

VALVE IDENTIFICATION	DESCRIPTION	VISUAL INSPECTION COMMENTS
WV-92-2	Vapor extraction well (VEW-92-2) manual flow control ball valve, PVC	
WV-92-3	Vapor extraction well (VEW-92-3) manual flow control ball valve, PVC	
WV-27A-1	Vapor extraction well (VEW-27A-1) manual flow control ball valve, PVC	
WV-96-1	Vapor extraction well (VEW-96-1) manual flow control ball valve, PVC	
WV-96-2	Vapor extraction well (VEW-96-2) manual flow control ball valve, PVC	
WV-96-3	Vapor extraction well (VEW-96-3) manual flow control ball valve, PVC	

TABLE i-6
SYSTEM HARDWARE

P&ID DESIGNATION	NAME/DESCRIPTION	MANUFACTURER	MANUFACTURER'S TELEPHONE NO.
1) EXTRACTION WELLS			
VAPOR EXTRACTION WELL PIPING COMPONENTS			
ROADWAY VAULTS			
VALVES AND FITTINGS			
2) VAPOR INLET SYSTEM			
VAPOR/LIQUID SEPARATOR	Vapor/Liquid Separator	Global Technologies, Inc.	(414) 332-5987
LIQUID STORAGE TANK	240 Gallon Condensed Liquid Storage	Poly-Cal Plastics, Inc.	(209) 982-4904
JUNCTION BOX	Level Switch and Pump Motor Class I Electrical Junction Box	Killark	
FE-01/FE-07/FE-25	Differential Pressure Flow Sensors	Veris, Inc.	(303) 449-0100
FT-07	Differential Pressure (Flow) Transmitter	Bristol Babcock, Inc.	(203) 575-3000
FILTER/SILENCER	Dilution Air Filter/Silencer	Solberg	(800) 698-4247
PI-02/PI-09/PI-13	Vacuum Gauges	Weksler Instruments Corp.	
LSL-3/LSH-3/LSHH-3/LSHH-5	Liquid Level Controls with Electronic Switches	Magnetrol	(708) 969-4000
BASKET STRAINER	Basket Strainer	Hayward Industrial Plastics	
P-1	Separator Drain Pump and Motor	MP Pumps (Pump); Marathon Electric (Motor)	(800) 843-2833; (715) 675-3311
CSL-375P-600F	In-line Particulate Filter	Solberg	(800) 698-4247
DPI-23	Differential Pressure Gauge	Dwyer	(219) 879-8000

P&ID DESIGNATION	NAME/DESCRIPTION	MANUFACTURER	MANUFACTURER'S TELEPHONE NO.
FSL-01/FE-01	Differential Pressure (Flow) Switch	Dwyer	(219) 879-8000
FI-01/FI-25	Differential Pressure (Flow) Gauge	Dwyer	(219) 879-8000
TE-15/TI-15	Thermowell and Thermometer	Weksler Instruments Corp.	
3) VAPOR TREATMENT SYSTEM			
CARBON ADSORBERS	Carbon Canisters	Fabricated Metals, Inc.	(909) 394-4500
CARBON	Granular Activated Carbon	Pure Effect, Santa Ana, CA	
4) VACUUM EXTRACTION MODULE			
SOUND ENCLOSURE AND SKID	Sound Attenuated Extraction Blower Enclosure and Frame	Power Generation & Engineering, Inc.	(209) 522-3230
EXTRACTION BLOWER	50 HP Extraction Blower	Tuthill, Corp., M-D Division	(417) 865-8715
PI-13	Vacuum Gauge	Weksler Instruments Corp.	
FE-14	Differential Pressure (Flow) Sensor	Tuthill, Corp., M-D Division	(417) 865-8715
FI-14	Differential Pressure (Flow) Gauge	Dwyer	(219) 879-8000
CSL-375P-600F	In-line Particulate Filter	Solberg	(800) 698-4247
DPI-22	Differential Pressure Gauge		
TE-17/TT-17/TI-17	Model 2800 Temperature Transmitter & Gauge	Transmation, Inc.	(716) 254-9000
PSV-18	Vacuum Relief Valve	Tuthill, Corp., M-D Division	(417) 865-8715
PI-16	Vacuum Gauge		
EXPANSION JOINTS	Expansion Joints	Tuthill, Corp., M-D Division	(417) 865-8715

P&ID DESIGNATION	NAME/DESCRIPTION	MANUFACTURER	MANUFACTURER'S TELEPHONE NO.
PI-20	Pressure Gauge	Tuthill, Corp., M-D Division	(417) 865-8715
TSHH-21/TI-21	Temperature Switch/Gauge	Tuthill, Corp., M-D Division	(417) 865-8715
DISCHARGE SILENCER	Discharge Silencer		
5) ELECTRICAL CONTROL SYSTEM AND POWER DISTRIBUTION MODULE			
TELEMETRY & CONTROL SYSTEM	Telemetry Control System Including Central Computer System, Remote Terminal Unit and Cabinet	Byrd Industrial Electronics	(909) 985-9191
AE-1/AE-11	Hydrocarbon Analyzer	HNU Systems, Inc.	(617) 694-6690
POWER DISTRIBUTION MODULE	Power Distribution Module Including Circuit Breakers, Power Block, Motor Starters, Transformer and Lighting Panel	Byrd Industrial Electronics	(909) 985-9191
TELEMETRY SYSTEM	Telesafe 6000 Telemetry System	Telesafe	(613) 591-1943
AS-1	Vapor Analyzer Sample Tap Inlet Concentration 1/4" NPT to tubing (1/4" dia.)	Swagelock	(602) 268-4848
AS-2	Vapor Analyzer Sample Tap Primary GAC Outlet Concentration 1/4" NPT to 1/4" tubing	Swagelock	(602) 268-4848
S-1	Vapor Sample Tap - 1/4" NPT to 1/4" tubing - vapor/liquid sep. inlet	Swagelock	(602) 268-4848
S-2	Vapor Sample Tap - 1/4" NPT to 1/4" tubing - primary GAC outlet	Swagelock	(602) 268-4848
S-3	Vapor sample Tap - 1/4" NPT to 1/4" tubing - primary GAC inlet	Swagelock	(602) 268-4848

P&ID DESIGNATION	NAME/DESCRIPTION	MANUFACTURER	MANUFACTURER'S TELEPHONE NO.
PF-1	Pitot Flow Monitoring Point Differential Pressure (5.5" ID Pipe - Vapor/liquid discharge)	Dwyer Instruments	(714) 630-6424
OP-92-1	Orifice Plate Differential Pressure Indicator VEW-92-1	Lambda Square	(516) 587-1000
OP-92-2	Orifice Plate Differential Pressure Indicator VEW-92-2	Lambda Square	(516) 587-1000
OP-92-3	Orifice Plate Differential Pressure Indicator VEW-92-3	Lambda Square	(516) 587-1000
OP-27A-1	Orifice Plate Differential Pressure Indicator VEW-27A-1	Lambda Square	(516) 587-1000
OP-96-1	Orifice Plate Differential Pressure Indicator VEW-96-1	Lambda Square	(516) 587-1000
OP-96-2	Orifice Plate Differential Pressure Indicator VEW-96-2	Lambda Square	(516) 587-1000
OP-96-3	Orifice Plate Differential Pressure Indicator VEW-96-3	Lambda Square	(516) 587-1000

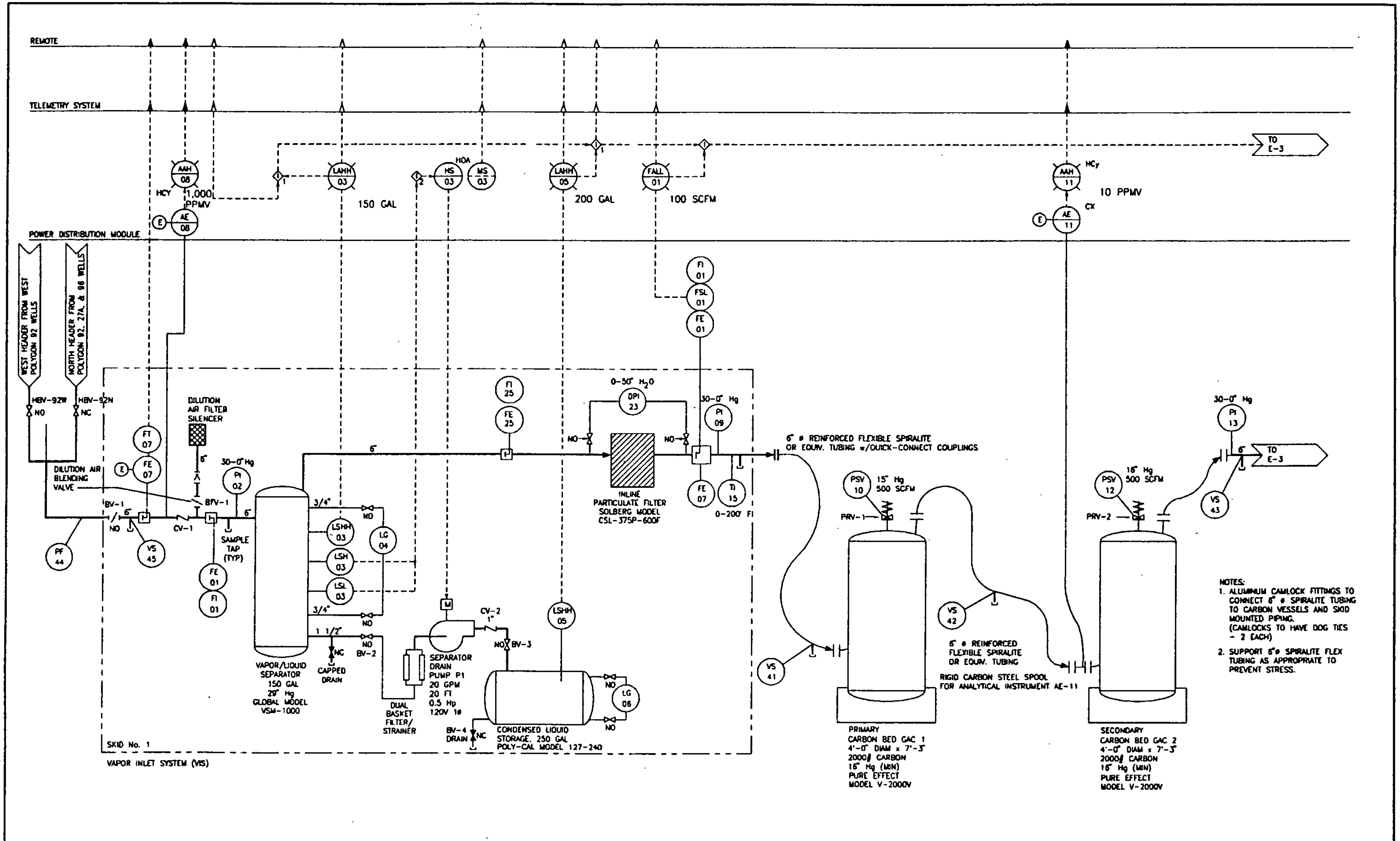
TABLE i-7
SVE VALVE LIST

VALVE IDENTIFICATION	DESCRIPTION	REFERENCE DRAWING
BV-1	Inlet header manual block valve, PVC	96-E-2
BV-2	Vapor/Liquid separator manual water shut off block ball valve, PVC	96-E-2
BV-3	Pump (P-1) manual water shut off block ball valve, PVC	96-E-2
BV-4	Condensate tank drain manual water shut off block ball valve, PVC	96-E-2
BV-5	Stack sump water drain manual gate block valve, cast	96-E-3
BV-6	Vapor/Liquid separator water drain valve PVC - ball	96-E-2
BFV-1	Air blending station manual butterfly valve, PVC	96-E-2
CV-1	Inlet header isolation spring (automatic) check valve, steel	96-E-2
CV-2	In-line automatic pump (P-1) backflow prevention check valve	96-E-2
CV-3	Vapor/Liquid separator pump (P-1) check valve - PVC	96-E-2
HBV-92N	Header butterfly valve, north header	96-D-1, 96-M-3
HBV-92W	Header butterfly valve, north header	96-D-1, 96-M-3
PRV-1	Automatic pressure relief valve for GAC-1, cast	96-E-2
PRV-2	Automatic pressure relief valve for GAC-2, cast	96-E-2
PSV-18	Vacuum relief valve	96-E-3
R-1	Blower recirculation manual gate valve, bronze	96-E-3
WV-92-1	Vapor extraction well (VEW-92-1) manual flow control ball valve, PVC	96-C-1
WV-92-2	Vapor extraction well (VEW-92-2) manual flow control ball valve, PVC	96-C-1
WV-92-3	Vapor extraction well (VEW-92-3) manual flow control ball valve, PVC	96-C-1
WV-27A-1	Vapor extraction well (VEW-27A-1) manual flow control ball valve, PVC	96-C-1
WV-96-1	Vapor extraction well (VEW-96-1) manual flow control ball valve, PVC	96-C-2
WV-96-2	Vapor extraction well (VEW-96-2) manual flow control ball valve, PVC	96-C-2

VALVE IDENTIFICATION	DESCRIPTION	REFERENCE DRAWING
WV-96-3	Vapor extraction well (VEW-96-3) manual flow control ball valve, PVC	96-C-2

TABLE i-8
ELECTRICAL CONTROL SYSTEM FUNCTION

IDENTIFICATION	DESCRIPTION	FUNCTION	COMMENTS
FE/FT-07	Flow element/transmitter	Monitors flow from wells	For solvent mass removal calculations
AE/AAH-08	Analytical element/alarm high	Monitors solvent concentration from wells	Alarm for concentration above set-point (1000 ppmV)
LSL/LSH/LSHH/LAHH/HS/MS-03	Level switch low/switch high/switch high-high/alarm high-high	Separator tank low and high level switches; controls pump to tank, high-high level alarm	Shuts down system at high-high level (Approx 200 gal. removal level)
LSHH/LAHH-05	Level switch high-high/alarm high-high	Condensate tank high level switch and alarm	Shuts down system on high-high level
FE/FSL/FI/FALL-01	Flow element/switch low/indicator/alarm low-low	Monitors flow into carbon	Low flow shuts system down. On an adjustable timer for start-up (150 scfm)
AE/AAH-11	Analytical element/alarm high	Monitors solvent concentration for primary carbon breakthrough	Alarm for concentration above set-point (10 ppmV)
TE/TT/TI-17	Temperature element/transmitter/indicator	Monitors temperature from carbon bed exhaust	Carbon efficiency
ISH/IAH-19 (HS/MS-19)	Current switch high/alarm high (Motor switch)	Motor overload protection	High current shuts down system
TSHH/TI/TAHH-21	Temperature switch high-high/indicator/alarm high-high	Monitors for high temperature from blower	High temperature shuts down system (350 F)



C:\GOODYEAR\96\96_E_2.DWG, 9/21/95

NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION
1	3-22-93			ELEC. PER MFG. CHANGE
2	10-26-93			CHANGES FOR RECORD DRAWING
3	2-94	SZ		POLYGON 94 DESIGN
4	5-95	KW		POLYGON 96/92/27A DESIGN

M&E METCALF & EDDY

DESIGNED ____ DRAWN ____ CHECKED ____

SCALE: NONE

SAN DIEGO, CA 1994 DATE

CALIF. P.E. No. ____

PGA - Goodyear

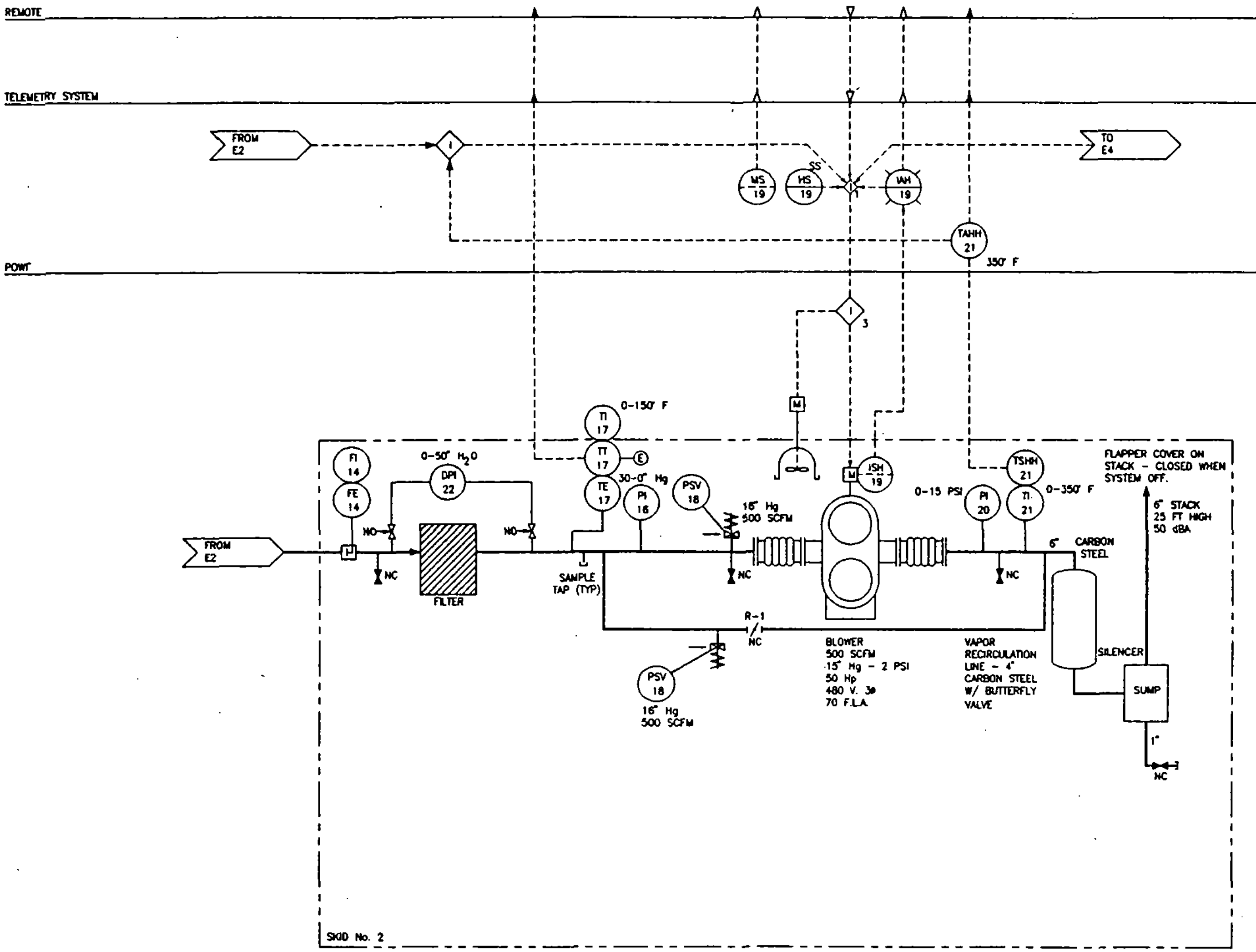
APPROVED ____ DATE

SOIL VAPOR EXTRACTION SYSTEM FINAL DESIGN - POLYGON 96/92/27A

PROCESS & INSTRUMENTATION DIAGRAM 1

DRAWING NO. 96-E-2

SHEET 17 OF 23 SHEETS



INTERLOCK NOTES:

1. LOCK OUT BLOWER WITH MANUAL RESET ON LOW FLOW FROM WELLS, HIGH-HIGH LEVEL IN AIR/WATER SEPARATOR, HIGH-HIGH LEVEL IN CONDENSED LIQUID TANK, BLOWER OVERLOAD, OR BY TELEMETRY

2. START CONDENSATE TRANSFER PUMP ON HIGH LEVEL IN AIR/WATER SEPARATOR, STOP PUMP ON LOW LEVEL IN AIR/WATER SEPARATOR

3. BLOWER CONTROL PANEL EXHAUST FAN TO START AND STOP AT THE SAME TIME AS BLOWER.

NOTE: ALL COMPONENTS SHOWN WITH EXCEPTION OF STACK AND SUMP MOUNTED ON CARBON STEEL BOX-TUBE SKID W/FORKLIFT OR CRANE LIFTING POINTS

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NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION
1	3-22-93	IB		ELEC. PER MFG. CHANGE
2	10-28-93	IB		CHANGES FOR RECORD DRAWING
3	2-94	SZ		POLYGON 84 DESIGN

METCALF & EDDY

DESIGNED ______ DRAWN ______ CHECKED ______

SCALE: NONE

SAN DIEGO, CA 1994 DATE

CALIF. R.E. No. ______

PGA - Goodyear

APPROVED ______ DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN - POLYGON 96/92/27A

PROCESS & INSTRUMENTATION DIAGRAM 2

DRAWING NO. 96-E-3

SHEET 18 OF 23 SHEETS

1.0 SVE SYSTEM COMPONENTS

Soils at some locations within the boundaries of the Phoenix Goodyear Airport (PGA) contain chlorinated solvent substances (referred to as solvent). Vapor extraction wells are constructed within the contaminated zones and piped to the SVE operable unit.

The SVE operable unit is designed to remove those solvents from the soils by drawing vapors from the soil to the treatment unit under a vacuum. The SVE system design is based upon the results of pilot testing conducted in 1988. The SVE Operable Unit final design is contained in the SVE Final Design Document submitted to the U.S. EPA on November 25, 1992. Appendix A of this manual contains the SVE System drawings for Polygons 96/92/27A.

Solvent laden soil vapors, once extracted from the subsurface, enter the treatment area via a one-way check valve (CV-1). Flow is measured downstream of the check valve. An air blending station is provided to dilute the solvent laden vapor stream. The air blending station contains a filter, to protect the treatment system from wind borne debris and a silencer to reduce noise levels from air entering the system piping. Solvent concentrations are measured at this point. Flow is also measured downstream of the air blending station.

Condensible liquids, mostly water, are removed from the solvent laden vapor stream by a vapor/liquid separator. Provisions are made for removing collected liquids from the vapor/liquid separator automatically using level controls and a pump. A condensed liquid storage tank is provided to hold the condensed liquids for proper disposal.

Dry solvent laden vapors are passed through a particulate filter and then into two activated carbon vessels in series, where the solvents are removed. The series arrangement of the carbon vessels reduces the chance that solvent vapors are not released to the atmosphere in the event that the adsorption capacity of the first, or primary, carbon bed is exceeded. A continuous vapor monitor is provided to monitor for breakthrough of the first bed.

The vacuum extraction blower downstream of the carbon vessels provides the suction necessary to remove the solvent vapors from the soil. The extraction blower is connected to the system with expansion joints to protect the rest of the system from vibration and thermal expansion. Clean soil vapors are exhausted from the extraction blower via a muffled stack.

The SVE operable unit is provided with automated instrumentation and controls. System performance can be monitored remotely by telemetry. If necessary, the system can be shut down from the remote monitoring station computer. However, the system must be started locally at the treatment area. P&ID Drawings 96-E-2 and 96-E-3 show the treatment system operation and key components. The remainder of this O&M manual identifies the key system components and describes how they should be operated and maintained.

1.1 EXTRACTION AND MONITORING WELLS

Each of the three polygons (96, 92 and 27A) contain one or more extraction/monitoring well pair. The number of extraction/monitoring well pairs allocated to each polygon is dependent upon the polygon area and design treatment radius or sub-area. In accordance with the site Record of Decision (ROD), a polygon sub-area is defined as the area of soil vapor extraction influence attributable to one SVE well. Operation of the SVE system in Polygon 79 revealed that a sub-area design radius in excess of 150 feet can be used.

In order to achieve SVE system coverage at the three polygons, seven extraction wells are required. The SVE system additionally includes nine monitoring wells, three existing wells installed during polygon Phase II investigations and six new wells. Extraction and monitoring well distribution is listed in Table 1-1 by polygon. The well boring and construction logs are included in Appendix C.

Soil texture conditions present in the site vadose zone are variable and consist of two subsurface strata. To accommodate the different soil types in the vadose zone, a dual-well/single borehole design was utilized for Polygon 79. However, field operation of Polygon 79 extraction wells and the SVE operable unit demonstrated that a fully-penetrating well would effectively draw vapors from both zones and be easier to operate and adjust while accomplishing the same remediation goals. Therefore, single completion wells screened through both strata are used for Polygons 96/92/27A.

TABLE 1-1
POLYGONS 96/92/27A EXTRACTION AND MONITORING WELLS

Polygon	No. of Well Pairs	Well Designation			
		Extraction Well	Status	Monitoring Well	Status
Polygon 96	3	VEW96-1	new	VP96-1A	new
		--	--	VP96-1B	new
		VEW96-2	new	VP96-2	new
		VEW96-3	new	VP96-3	existing
Polygon 92	3	VEW92-1	new	VP92-1	existing
		VEW92-2	new	VP92-2	new
		VEW92-3	new	VP92-3	new
Polygon 27A	1	VEW27A-1	new	VP27A-1	existing
				VP27A-2	new

Each extraction well is brought to just below the ground surface in a covered traffic box and connected to the SVE Treatment unit via a main header pipe. Each well contains a manual ball-type isolation valve and one soil vapor sample port for sample collection. The interconnected piping system is composed of PVC pipe and ranges from 3 inches to 6 inches in diameter. It transports the extracted solvent vapors from the well heads to the vapor treatment system. Well locations and piping configurations are depicted on the system design drawings in Appendix A. At the treatment system, a check valve (CV-1) is provided to preclude flow from the SVE treatment unit into the wells and a block valve (BV-1) is provided to manually isolate the wells from the treatment unit.

1.2 VAPOR INLET SYSTEM

The vapor inlet system consists of an air blending station and a vapor/liquid separator. See Table i-5 for a listing of the SVE system valves. A block valve (BV-1) and check valve (CV-1) are provided on the vapor inlet skid to isolate the treatment system from the extraction wells and to prevent backflow from the treatment system into the extraction wells, respectively. The entire vapor inlet system is mounted on a 8 foot by 12 foot structural steel skid equipped with a non-skid deck and lifting lugs.

1.2.1 Air Blending Station. Solvent laden air passing the block valve (BV-1) and check valve (CV-1) enters the vapor inlet portion of the treatment system. An air blending station, to provide ambient air to the system, is located just prior to the vapor/liquid separator. The station is composed of an 6 inch tee, a butterfly valve (BFV-1) which opens to the atmosphere, and a Solberg F Series filter/silencer. The Solberg F Series filter/silencer is provided to protect the SVE system from wind borne debris and reduce noise from the air stream entering the piping. The butterfly valve (BFV-1) should remain closed when the system is not in operation or when the entire treatment stream is from the extraction wells.

1.2.2 Vapor/Liquid Separation. Vapor/liquid separation occurs in a centrifugal force pressure drop vapor/liquid separator unit with internal baffling and a discharge coalescing filter. The vapor/liquid separator contains a 150 gallon water reservoir for water storage. An automatically actuated pump (P-1) is used to evacuate the vapor/liquid separator reservoir into a cross-linked high density polypropylene 240 gallon condensed liquid storage tank. The materials of tank construction are compatible with expected contaminants which might be present in the condensed liquid.

Liquid level controls are contained in the separator unit which control pump P-1 that evacuates the water reservoir, as well as a high level shut down switch. The separator is made of carbon steel construction that contains a rust-inhibiting coating and is manufactured by Global Technologies, Inc.

The water pump (P-1) is Model 5 self-priming aluminum centrifugal pump manufactured by M P Flomax and driven by a 0.5 hp, 1000 rpm Marathon Electric standard induction explosion proof motor. The pump is rated for 20 gpm at 20 feet of water head.

The liquid level in the vapor/liquid separator and the condensed liquid 240 gallon storage tank actuates Magnetrol switches. Each switch is pivot mounted, with a float on one end and a magnet on the other. When the liquid level either rises or falls past the switch location, the magnet moves. An electric switch adjacent to the magnet is actuated by the movement of the magnet. The Magnetrol switches actuated in this manner are vapor/water separator switches LSL-03, LSH-03 and LSHH-03 and condensed liquid storage tank switch LSHH-05. A high high level switch contained in the condensed liquid storage tank is also used as a shut down switch. **The water level in the vapor/liquid separator shall be maintained above LSL-03 at all times to ensure pump prime.**

Flow element and transmitter, FE-07/FT-07 are located upstream of the air blending station.

1.3 VAPOR TREATMENT SYSTEM

The vapor treatment system consists of carbon canisters, connecting pipe spool pieces, reinforced flexible tubing and vacuum relief vents. The carbon canisters are designed to be placed on a firm surface, such as asphalt, compacted earth, or pavement, and connected in series using flexible connecting tubing.

1.3.1 Carbon Canisters. The carbon canisters are manufactured by Fabricated Metals, Inc. and consist of two granular activated carbon (GAC) filled adsorber vessels in series (GAC-1, primary and GAC-2, secondary), and associated piping, duct work and valves. The adsorber vessels are cylindrical with dished ends and stand vertical. Each is nominally 4 feet outside diameter and 7.5 feet high. The forklift channeled skids on the bottom and connection fittings at the top make the overall height of each carbon vessel 8 feet 9.25 inches. The carbon adsorber vessels are of carbon steel construction. Each tank contains nominally 2,000 pounds of activated carbon supported by 18 gage stainless steel screens. The interior of the adsorber tanks are coated with an acid-resistant epoxy coating. The vessels are rated to 16 inch Hg vacuum. A third, 2,000-pound standby carbon canister, GAC-3, is provided on-site for backup. Each GAC vessel contains a vapor sample tap/valve at the inlet for emission/treatment monitoring. These sample locations carry the nomenclature SV-41 and SV-42. See Drawing 96-E-2 in Appendix A.

1.4 VACUUM EXTRACTION MODULE

The vacuum extraction module consists of an in-line particulate filter, vacuum extraction blower and 50 hp electric motor, expansion joints (upstream and downstream of blower), discharge silencer, sump, exhaust stack, and roof-mounted heat exhaust fan. A blower control panel is mounted on the blower enclosure on a box tube frame. Expansion joints are provided to isolate motor vibration and thermal expansion from other portions of the SVE operable unit. The extraction blower sound attenuated enclosure and discharge silencer are designed to reduce noise levels as required. The discharge stack is provided with a hinged exhaust flapper and sump to prevent water, from precipitation, from flowing back into the blower.

Flow is measured upstream of the in-line filter (FE-14/FI-14). Differential pressure is indicated across the in-line filter (DPI-22) and temperature and pressure are measured both upstream and downstream of the extraction blower.

1.4.1 Extraction Blower. The extraction blower is an M-D Pneumatics Model 5514, 2-lobe rotary positive type extraction blower. The blower is driven by a 50 Hp, TEFC motor via a V-belt drive. The blower is rated for 500 scfm at 15 in. Hg vacuum and 2 psi pressure. Protective devices built into the motor are designed to shut the system down in the event of high motor winding current. The blower contains a vapor recirculation line and flow adjustment valve (R-1) for minor system flow adjustment.

1.5 ELECTRICAL CONTROL SYSTEM AND POWER DISTRIBUTION MODULE

1.5.1 Electrical Control System. The electrical control system consists of skid mounted (shares skid with the power distribution module) remote terminal unit in a NEMA 7 rated enclosure. The electrical control system contains the HNu Model 201 photoionization detector continuous gas monitor, a Control Microsystems TeleSAFE 6000 control and data acquisition unit and various supporting electronic components. A remote IBM PC compatible MS Dos based computer system with a 2400 baud modem for connection via standard telephone line is used to remotely monitor and shut down the SVE Operable Unit. In addition to the remote monitoring TeleSAFE device, a RACO Chatterbox, Model CB-4 autodialer is provided to automatically notify of system alarm conditions.

1.5.2 Power Distribution Module. The power distribution module ties into the existing site electrical substation and distributes power to the various electrical usage components of the SVE Operable Unit. These include the extraction blower, the electrical control and telemetry panel "A", the separator drain pump and the electrical control and telemetry panel "B".

The power distribution module is contained within a skid mounted cabinet (skid shared with the electrical control system). Power from the site substation at 480 volts is routed through a 200 ampere circuit breaker into a power block. 480 volt, 3 phase power from the power block is sent to a 150 ampere circuit breaker and then to a size 3 motor starter for the extraction blower motor. A 15 ampere circuit breaker, connected to two legs of the power leaving the power block, is brought to a transformer, where electrical services is provided for a lighting panel and the separator pump motor controller. The lighting panel provides power for telemetry and controls, as well as auxiliary power for other desired services including utility outlets and lighting.

2.0 PROCESS DESCRIPTION/CONTROL

2.1 PROCESS DESCRIPTION

During normal operation of the SVE Operable Unit, solvent vapor, consisting of primarily chlorinated solvents, will be drawn from the soil within a given subsurface area by isolating the extraction wells located in the given area.

The solvent concentration of the SLA (Solvent Laden Air) is reduced, if necessary, to below 25 percent of the Lower Explosive Limit (LEL) by mixing ambient air in the air blending station. It is anticipated that the solvent laden air from the wells will be less than 4,000 ppmV (approximately 25 percent of the LEL) under all operational conditions. Currently, no LEL monitoring is provided due to the low (under 2,000 ppmV) solvent concentrations encountered.

The air blending station also serves to provide ambient air to the system for start-up and maintenance activities. During this mode of operation, flow from the extraction wells can be prevented with the block valve (BV-1), thereby allowing various system components to be operated without violating regulatory requirements, air discharge limits or other conditions of operation. Solvent concentrations are monitored downstream of the air blending station. Flow is monitored both upstream and downstream of the air blending station to determine total air blending ratios.

As the air/solvent mixture is drawn from the extraction wells, it will pass through the vapor/liquid separator on the inlet side of the blower system. Here, any liquid which has condensed out of the SLA will be separated from the SLA. The vapor/liquid separator operates under the extraction system vacuum. Thus, solvents dissolved in the water would, due to their relatively high vapor pressure, be removed from the water.

The vapor/liquid separator is equipped with a 150 gallon water chamber. The water chamber in the vapor/liquid separator is equipped with mechanical level switches that control the water pump (P-1). When the condensed liquid in the chamber reaches a preset level, the water pump (P-1) is energized. Approximately 90 gallons can accumulate between the low and high level switches.

The water is pumped to a 240 gallon condensed liquid storage tank. The condensed liquid holding tank, located adjacent to the vapor/liquid separator, contains a high level system shutdown switch to prevent over-filling and/or spillage. The condensed liquid storage tank should be emptied after two pumping cycles; it does not have the capacity to contain the entire contents of a third vapor/liquid separator chamber volume and would cause the SVE system to automatically shut down if a third vapor/liquid separator volume were attempted to be pumped to the condensed liquid storage tank.

The air/solvent mixture will then pass through the Granular Activated Carbon (GAC) tanks. Inside the GAC tanks, Volatile Organic Compounds (VOC) including TCE, 1,1,1-TCA, 1,1-DCE, and PCE are adsorbed in a bed of high grade activated carbon. The carbon bed will continue to adsorb VOCs until it reaches its saturation at which time it must be regenerated or replaced.

The length of time that a GAC tank remains in service will be determined by GAC breakthrough instrumentation. Initially, carbon changeouts might occur relatively frequently. As the remediation progresses, however, GAC units can be expected to provide longer service.

Upon relocation of the SVE Operable Unit to a new polygon to be remediated, M&E will utilize a field gas chromatograph (GC) to characterize the solvent materials in the contaminated soils. The results of the soil vapor characterization will be used to estimate the carbon adsorption efficiency for the polygon-specific conditions. The results will then be used to calibrate the photoionization detector and to prepare a monitoring program specific to the conditions of the polygon under remediation.

When carbon VOC breakthrough of the primary carbon bed begins, the Carbon Adsorption System Vapor Analyzer will automatically detect the breakthrough and send the signal to the telemetry unit. The system has been designed with a two-tank series adsorption configuration to prevent releases to the atmosphere from solvent breakthrough. A photoionization detector which samples the "clean" air on the discharge header of the primary CAS will continuously monitor the "clean" air stream. If a solvent concentration above a pre-set level is detected, M&E can shut the system down via the telemetry unit or the site system shut-down switch. Following the breakthrough, M&E will schedule a carbon changeout.

Once the solvent vapors pass through the CAS, they are drawn to the blower system and exhausted out the blower discharge stack. Prior to stack discharge, the blower exhaust is routed through a discharge silencer to silence the blower exhaust.

2.2 INSTRUMENTATION/CONTROLS

All of the components of the SVE Operable Unit are designed to operate as an integrated package and, therefore, only one main control panel is used. Additional instrumentation and a telemetry unit have also been provided which tie the components together into an integrated system. This section describes the instrumentation and control of each component as well as the system as a whole.

2.2.1 Extraction Wells. Section 6 of this O&M Manual provides details of the extraction well operation and operational guidelines for sub-area and polygon remediation.

2.2.2 Vapor Inlet System.

Liquid Level. The vapor/liquid separator is equipped with mechanical level switches for controlling the water pump (P-1) and for sensing high liquid level in the separator.

If a high liquid level (LSH-03) in the separator is sensed, the water pump will be started and run until the low liquid level (LSL-03) is reached. If a high-high level (LSHH-03) is sensed, an alarm signal (LAHH-03) will be sent to the main control panel to shut the system down.

When the water level in the vapor/liquid separator tank reaches the high/high level either the condensate pump has failed or the condensate liquid storage tank is full (LSHH-05), the system will be shut down and alarmed. Check both tank levels (LG-03 and LG-06) before restarting the system.

Liquid level within the separator is locally indicated (LG-03). **The liquid level must remain above the low level indicator on the sight glass.** Monitor liquid level on a daily to weekly basis as needed.

Vacuum. Vapor/liquid separation inlet vacuum (PI-02) is indicated locally.

Pressure Drop. Pressure drop across the carbon in-line particulate filter is indicated locally (DPI-23).

Flow. Flow of the SLA into the operable treatment unit is measured by flowmeter FE-07 and transmitted as a 4 to 20 mADC signal for monitoring via the electrical control system. The air exhaust line of the vapor/liquid separator contains an in-line particulate filter followed by a low air flow switch (FSL-01). In the event of system piping or filter blockage, low air flow (less than 150 scfm) will result, which will automatically shut down the system (FSC-01). See Drawing 96-E-2.

When the blower is first started, the low air flow switch is inhibited from locking out the blower until timer TDR times out, normally set for 20 seconds. After the 20 seconds if there is low air flow, the system will be shut down and will require manual restart.

Vapor Solvent Concentration. The solvent concentration of the untreated and undiluted extracted vapor upstream of the air blending station is monitored via a remote mounted photoionization detector (AE/AAH-08). The programmable controller will indicate a high level alarm at 1000 ppmV total solvents, calibrated for 460 ppmV TCE.

2.2.3 Vapor Treatment System. A programmable logic controller is used to monitor functions of the vapor treatment system. All valves, dampers, etc. of the vapor treatment system are manually operated. See Table i-5, Annual SVE Valve Inspection List.

Temperature. Carbon canister inlet vapor temperature (TI-15) is indicated locally.

Pressure Drop. Pressure drop across the carbon in-line particulate filter is indicated locally (DPI-23).

Vacuum. Vacuum in the line entering the primary carbon (PI-09) and leaving the secondary carbon (PI-13) is indicated locally. PI-09 is located downstream of the carbon in-line particulate filter. PI-13 is located upstream of the blower in-line particulate filter.

Vacuum Relief. High carbon bed vacuum will result in opening of relief valves PSV-10 and PSV-12 on the primary and secondary carbon beds, respectively.

Vapor Solvent Concentration. The solvent concentration of the treated vapor between the primary and secondary carbons is monitored via a remote mounted photoionization detector (AE/AAH-11). The programmable controller will indicate a high level alarm at 10 ppmV. In the event of a high solvent concentration alarm, the programmable controller will notify M&E and Phoenix area response personnel by telephone for system response. To verify the photoionization detector response, sample parts SV-41, SV-42 and SV-43 have been provided. See Drawing 96-E-2 in Appendix A.

2.2.4 Vapor Extraction Module. The vapor extraction blower module is designed for continuous operation. Gauges on the extraction blower motor indicate motor lubricating oil pressure and lubricating oil temperature. The extraction blower can be shut down locally, automatically in response to an alarm condition, or remotely; however, it must be restarted from the on-site electrical control system.

Motor Winding Current. Motor winding current is monitored by the electrical control system (ISH/IAH-19). High motor winding current will result in an alarm and system shutdown to protect the extraction blower motor.

Vacuum/Pressure. Vacuum of the vapor stream entering the extraction blower (PI-16) and pressure of the exhaust stream from the extraction blower (PI-20) are indicated locally.

Pressure Drop. Pressure drop across the extraction blower in-line particulate filter is indicated locally (DPI-22).

Temperature. Extraction blower inlet temperature (secondary carbon exhaust temperature) is indicated locally and monitored by the electrical control system (TI/TE/TT-17). Extraction blower exhaust temperature (TI/TSHH-21) is also indicated locally and monitored by the electrical control system. High extraction blower exhaust temperature, above 325F, will result in automatic system shutdown.

2.2.5 Electrical Control System and Power Distribution Module.

Electrical Control System. The electrical control system, consisting of the programmable controller, the telemetry system, the remote computer system and the photoionization detectors receive electrical signals from system components. Table 2.2.5-1 summarizes the function of the electrical control system.

If the electrical control system receives an alarm signal from any component of the vapor extraction system, it will send a shutdown signal to the blower system and the carbon adsorption system. A pilot light on the main control panel will indicate the source of the alarm signal (blower system, carbon adsorption system, vapor/liquid separator, or photoionization detector).

Photoionization Detector. A photoionization detector (PID) has been provided to continuously monitor solvent concentrations in the "clean" air stream between the carbon adsorption system primary and secondary beds. The PID stores data in a remote terminal unit which downloads to a computer to provide a record of hydrocarbon concentration.

If the hydrocarbon concentration exceeds a preset high level, the PID will send an alarm signal to the system control panel. This signal will cause the system to notify the local technician via telephone and M&E via telemetry to service the unit. At this point, the system operator has the option of immediately responding to the unit or shutting the system down via telemetry and then responding to the unit.

System shutdown/start-up interlocks include:

1. Low air flow in system from wells (FALL-01)
2. High-high level in vapor/liquid separator (LAHH-03)
3. High-high level in condensed liquid storage tank (LAHH-05)
4. Blower current overload (IAH-19)
5. Blower exhaust high-high temperature (TAHH-21)
6. Telemetry lock-out

Power Distribution Module. The power distribution module supplies electrical energy to the system components. Direct interactions occur between the field components of the SVE Operable Unit and the electrical control system. The electrical control system can shut down the SVE Operable Unit by stopping the extraction blower. Table 2.2.5-1 identifies conditions which would result in system shut down via this mechanism. Note that if the system is shut down, either automatically or manually, check valve CV-1 will automatically close, preventing solvent laden air from entering the system.

Table 2.2.5-1
ELECTRICAL CONTROL SYSTEM FUNCTION

IDENTIFICATION	DESCRIPTION	FUNCTION	COMMENTS
FE/FT-07	Flow element/transmitter	Monitors flow from wells	For solvent mass removal calculations
AE/AAH-08	Analytical element/alarm high	Monitors solvent concentration from wells after dilution	Alarm for concentration above set-point (1000 ppmV)
LSL/LSH/LSHH/LAHH	Level switch low/switch high/switch high-high/alarm high-high	Separator tank low and high level switches; controls pump to tank, high-high level alarm	Shuts down system at high-high level (Approx 200 gal. removal level)
LSHH/LAHH-05	Level switch high-high/alarm high-high	Condensate tank high level switch and alarm	Shuts down system on high-high level
FE/FSL/FI/FALL-01	Flow element/switch low/indicator/alarm low-low	Monitors flow into carbon	Low flow shuts system down. On an adjustable timer for start-up (150 scfm)
AE/AAH-11	Analytical element/alarm high	Monitors solvent concentration for primary carbon breakthrough	Alarm for concentration above set-point (10 ppmV)
TE/TT/TI-17	Temperature element/transmitter/indicator	Monitors temperature from carbon bed exhaust	
ISH/IAH-19 (HS/MS-19)	Current switch high/alarm high (Motor switch)	Motor overload protection	High current shuts down system
TSHH/TI/TAHH-21	Temperature switch high-high/indicator/alarm high-high	Monitors for high temperature from blower	High temperature shuts down system (350 F)
HS-03	Hand-Off-Automatic selector switch	Operates P-1 in HAND or allows automatic operation	In OFF, P-1 will not operator
MS-03	Motor switch	Indicates pump P-1 motor is operating	Lamp on panel and monitoring system

3.0 START-UP PROCEDURES

The SVE Operable Unit must be started in the field from the electrical control system control panel. Two modes of start-up, initial system start-up and restart, can occur. Initial system start-up involves getting the SVE Operable Unit up and running, then gradually introducing solvent laden air to the system. Restart would occur when the system is shut down during operation (e.g. carbon changeout) and is subsequently made ready to go back into operation.

3.1 PRIOR TO EXTRACTION BLOWER OPERATION

3.1.1 Extraction Wells. Isolate the extraction wells by closing the wellhead ball valves at the wells. Close the block valve (BV-1) on the 6-inch main header. Check all piping connections and close all sample taps. Check all traffic covers.

3.1.2 Vapor Inlet System. Check all liquid and vapor piping connections. Make sure all sample taps are closed. Check all gauges and instruments for zero or proper settings with system not operating. For Polygon 96 operation, fully open HBV-92N to allow vapor to flow from the Polygon 96 header network. For Polygon 92 operation, fully open HBV-92N and HBV-92W. For Polygon 27A operation, fully open HBV-92N.

Filter/Silencer. Check the dilution air filter/silencer for proper installation and also for dirt and debris. Correct as necessary. Open fully air blending valve (BFV-1), at treatment unit.

Vapor/liquid Separator and Condensed Liquid Storage Tank. Prior to gas operation, follow the start-up procedure as described below:

1. Close the isolation valve (BV-2) on the inlet to the separator pump (P-1) and remove the 16 inch diameter inspection manhole from the vapor/liquid separator.

2. Wash down the sides of the vessel with water until the liquid level approaches the vapor inlet.

3. Ensure that the simplex basket strainer has a clean screen and basket. Inspect, and, if necessary, replace, the in-line filter cartridge.

4. Ensure that the dual basket filter/strainer has a clean basket and filter cartridge. Inspect, and, if necessary, replace the filter cartridge.

5. Open isolation valves (BV-2, inlet and BV-3, discharge) on both pump (P-1) inlet and discharge and close isolation valve (BV-4) on the liquid storage tank drain.

6. Set the separator drain pump selector switch on "hand" at the electrical control system and run the pump for 5 minute intervals. Isolate the pump between intervals using the isolation valves (BV-2 and BV-3) and clean the basket strainer and screen. Continue with this step until the basket strainer is free of large particles, indicating that the vapor/water separator is clean.

7. Open the inspection manhole on the liquid storage tank and wash down the sides. Drain the tank to an acceptable discharge point (vacuum truck).

8. Set the selector switch on the electrical control system to the "off" position and open all isolation valves (BV-2 and BV-3).

Before filling the vapor/liquid separator, the electrical panel must be ready and the water lines must be filled with water and the pump, P-1, must be tested for proper rotation and operation.

Carbon In-line Particulate Filter. Check to see that the carbon in-line particulate filter has a clean filter element and that the inspection opening is sealed tight against the filter housing. Check that filter differential pressure indicator isolation valves are "OPEN".

3.1.3 Vapor Treatment System. Check all piping and spirolite tubing connections. Make sure all sample taps are closed. Check all gauges and instruments for zero or proper settings with system not operating.

Carbon Canisters. Check that both carbon canisters are placed solidly on the ground surface and do not wobble or rock. Confirm that activated carbon has been properly installed in the canisters and that the canisters are properly closed and sealed. Confirm the tubing connections are correct for proper series operation. Check the analyzer connection; it should be between the primary and secondary carbon.

Vacuum Relief Valves. Check the vacuum relief valves (PRV-1, for GAC-1 and PRV-2, for GAC-2) for clearance from obstructions which could block them or objects which could be sucked into them.

3.1.4 Vacuum Extraction Module. Check all piping and expansion joint connections. Make sure all sample taps are closed. Check all gauges and instruments for zero or proper settings with system not operating.

Blower In-line Particulate Filter. Check to see that the blower in-line particulate filter has a clean filter element and that the inspection opening is sealed tight against the filter housing. Check that filter differential pressure indicator isolation valves are "OPEN".

Extraction Blower. Fill the blower oil reservoir with recommended non-detergent oil, as described on Page 5 of the M-D Pneumatics blower manual. Check oil level in sight glass. Check for proper unrestricted blower rotation by rotating the shaft by hand several times to ensure no rough spots, unevenness or hang-ups. Place the blower selection switch on the electrical control system to "HAND" and ensure that the blower and motor rotational directions are as that indicated above the shafts on the housing. Alter the motor leads if rotation is in the wrong direction. Reset the blower selector switch to "OFF".

Discharge Silencer, Sump and Stack. Check that the discharge silencer, sump and stack are all firmly mounted and supported. Check to see that the sump is empty and close sump drain, BV-5. Check that stack flapper rain cover moves freely and falls to the closed position when the system is not being operated.

3.1.5 Electrical Control System and Power Distribution Module. Make sure all connections from the SVE Operating Unit equipment to the electrical control system and power distribution module are in place and secure. Check that power is available and that all fuses and circuit breakers are operational. Electrical checks must be conducted prior to running system.

> **SAFETY WARNING: MAKE SURE THERE ARE NO EXPOSED WIRES OR ELECTRICAL CONNECTIONS. ALL COVERS, GUARDS, AND HATCHES NOT NORMALLY ACCESSIBLE DURING OPERATION SHOULD NOW BE PROPERLY CLOSED!**

3.2 INITIAL START-UP

3.2.1 Extraction Wells. Open the well ball valves from one well (Reference Section 6 for detailed well operation during start-up and operation). Check to see that the main block valve (BV-1) is closed and dilution air valve (BFV-1) is open. Once system is running, open main block valve (BV-1) and gradually close the dilution air valve (BFV-1) until the desired well air flow is reached. After system is operating on extraction well vapors, wells may be closed (off-line) or opened (on-line) as desired. Sample taps should remain closed, but may be opened for sampling as needed.

3.2.2 Vapor Inlet System. Initially, the block valve (BV-1) from the extraction wells should be closed. The butterfly valve (BFV-1) of the air blending station should be wide open. Check all liquid and vapor piping connections. Make sure all sample taps are closed, except when sampling. Check all gauges and instruments for proper reading and calibration.

Air Blending Station. Upon start-up, the air blending valve (BFV-1) should be opened fully. As the extraction wells are brought on-line, the air blending valve (BFV-1) may be closed or partially closed, as desired to achieve the required well vapor flow and dilution.

Vapor/Liquid Separator and Condensed Liquid Storage Tank. Open isolation valves (BV-2 and BV-3) on both pump (P-1) inlet and discharge and close isolation valve (BV-4) on the liquid storage tank drain. Check, via LG-03, that the water level in the separator storage tank is above the low level switch, LSL-03. Set the separator pump switch to the "AUTO" position on the electrical control system.

3.2.3 Vapor Treatment System. No adjustments are needed following 3.1.3.

3.2.4 Vacuum Extraction Module.

Extraction Blower. Set the extraction blower selector switch to "AUTO" and press the blower "RESTART" switch to start the system. Operate blower recirculation valve, R-1, as necessary to achieve the desired flow and blower exit temperature conditions.

3.2.5 Electrical Control System and Power Distribution Module. Check all instruments for operation on ambient air. In general, all instruments have been factory calibrated. Check all calibrations per Section 1, pages 2 through 4 of Appendix B, the AFS O&M Manual. This section highlights some of the more commonly needed calibration methods.

Flow FI-01, FI-14 and FI-25 (based on Temperature and Pressure). Using the gauge values of pressure and temperature from PI-16, TI-17 and PI-20, and Figure 3.2.5-1, Vacuum Slip Curve (also shown in Appendix B, AFS O&M Manual, Section 4) for the actual flow at 3097 RPM, one can calculate the actual flow that should be read from both FI-01, FI-14 and FI-25 using the following equation:

$$\mathbf{SCFM = ACFM \times (520/(TI\text{-}17+460))\times(PI\text{-}16/29.92)}$$

Refer to Appendix B, AFS O&M Manual tabbed dividers: Section 2, No. 11 and Section 4, No. 2 to recalibrate FI-01 and FI-14.

Flow Switch Low (FSL-07). FSL-07 is precalibrated to shut the system down at 150 SCFM. If only ambient air is used (well header is closed) throttling the air blending station butterfly valve (BFV-1) to 150 SCFM should result in system shutdown. A preferred procedure is to reduce incoming flow by opening the recirculation valve (R-1), reducing flow to the desired system shutdown flow rate of 150 SCFM at FSL-07 without placing a strain on the extraction blower. FSL-07 can be recalibrated following the Dwyer procedure of Appendix B, AFS O&M Manual tabbed dividers: Section 2, No. 10.

Temperature Transmitter (TT-17). A personal computer plugged into the serial port of the TeleSAFE 6000 can be used to check the calibration of TT-17 against the gauge value of TI-17. TI-17 (and all temperature indicators) can be calibrated against a pre calibrated field thermometer or thermocouple inserted into a sample tap. TT-17 and TI-17 both can be recalibrated following the procedure of Appendix B, AFS O&M Manual tabbed dividers: Section 4, No. 5.

Temperature Switch High-High (TSHH-21). Opening the recirculation line valve (R-1) should increase the blower discharge temperature above the TSHH-21 system shutdown threshold of 325 F. If the gauge reading TI-21, does not correspond to system shutdown at 325 F, both the gauge TI-21 and the switch TSHH-21, should be recalibrated following the procedure of Appendix B, AFS O&M Manual tabbed dividers: Section 4, No. 11.

If system shutdown does not occur when the recirculation valve (R-1) is opened because the temperature does not reach 325 F, or if system shutdown results from low flow at FSL-01, contact M&E.

Hydrocarbon Analyzer HNu. The HNu Photoionization Detector (PID) should be calibrated following the procedure of Appendix B, AFS O&M Manual tabbed dividers: Section 5, Tabbed Divider No. 12, page 6-1 of the HNu Manual. Check the instrument particulate filter and lamp window and clean if necessary.

The PID should be calibrated weekly using a calibration gas which results in instrument deflection of 50 to 75 percent of the scale. Because over 97 percent of the target compounds for the worst soil sample (ID# 9206123B) is trichloroethylene (TCE) a pure TCE standard of 460 ppmV shall be used. The instrument alarm range is 1000 ppmV (AE-08) down to 10 ppmV (AE-11).

A standard of 460 ppmV TCE in zero air should be used, with the span control setting at 8.2 (HNu Manual, Table 8-14) at a 50 percent deflection on the scale. The 100 percent scale will read 1000 ppmV. The selection of calibration gas should be reviewed as necessary throughout the progress of the project.

3.3 OPERATION WITH SOLVENT LADEN AIR

Initial operation of the SVE Operable Unit or following a period of extended down-time or major service, the unit should be operated for a minimum of 24 hours while checking all components for proper operation. Monitor all gauges upon full load start-up and then after 24 hours. Check for proper operation of blower system components including high pressure shutoff, belt tension, filter elements, and lubricating fluids as described in Appendix B, AFS O&M Manual.

3.3.1 Extraction Wells. Open the wellhead ball valves as necessary at desired extraction wells. With the blower running and the air blending station valve (BFV-1) fully open, slowly open the block valve (BV-1) to the wellheads. Increase the load on the blower and begin the flow of solvents from the wellheads by partially closing the air blending valve (BFV-1). The header block valve (BV-1) should be fully open during system operation; it is not a throttling valve. If flow control from the wells is desired, such flow control will be achieved by adjusting the valves at the individual wellheads, as described in Section 6.

Monitor the PID concentrations of the SLA as the air blending valve is slowly closed. MAINTAIN THE SOLVENT CONCENTRATION IN THE SLA BELOW 25 percent OF THE LEL (4,000 ppmV). If the alarm AAL-08 indicates 1,000 ppmV, maintain concentrations below 1,000 ppmV by maintaining the air blending station valve (BFV-1) partially open.

3.3.2 Vapor Inlet System.

Air Blending Station. Monitor the inlet vapor concentration (AE-08) and air blending station dilution valve (BFV-1) to maintain concentrations below 1000 ppmV.

Upon initial start-up of the VES, the air blending valve should be throttled so that the solvent concentration of the SLA does not exceed 25 percent of the LEL (4,000 ppmV). It is anticipated that solvent concentration will decrease with time for a given set of extraction wells on-line. Therefore, solvent concentrations in the SLA must be monitored on a daily basis (or as necessary) and the air blending valve throttled accordingly to maintain a solvent concentration in the SLA below 25 percent of the LEL.

Vapor/Liquid Separator. Periodically observe the liquid level in gauge LG-03 of the separator and LG-06 of the condensed liquid storage tank. Plan to empty the 240 gallon condensed liquid storage tank when it has received 2 separator volumes of condensed liquid (180 gallons).

Flow FI-07 (based on System Shutdown). Refer to Appendix B, AFS O&M Manual Section 2, Page 3-1 of the Bristol Babcock manual. Upon calibration of FT-01 to confirm system shutdown at 150 SCFM, by slowly closing the main header valve (BV-1) and the air blending valve (BFV-1) until shutdown occurs. Alternatively, the flow rate can be reduced by opening the blower recirculation valve (R-1). Using R-1 to reduce system inlet air flow is preferred because strain on the extraction blower is reduced. The main header valve (BV-1) should not be used as a throttling valve for normal system operation. The analog value of FT-07 can then be compared with FT-01 and FT-25 flow readings.

3.3.3 Vapor Treatment System.

Carbon In-line Particulate Filter. Check the pressure drop (DPI-23) across the filter. Check the filter condition if it registers 10 inches water or greater.

Carbon Canisters. Monitor the primary carbon canister (GAC-1) for breakthrough. Estimated time to breakthrough will be based on inlet flow and solvent concentration at the inlet. Plan for replacement of carbon as needed.

When the primary carbon canister discharge stream indicates 10 ppmV or greater on the photoionization detector, AE-11, alarm AAH-11 will indicate breakthrough and it is time to remove the carbon canister from service and replace the spent carbon with fresh carbon.

One aspect of the system operation is monitoring the in-line continuous PID monitor between carbon canisters (GAC 1 and GAC 2) to evaluate when breakthrough occurs. The mass loading for the various compounds will be determined by using the estimated mass of contaminants withdrawn from the soil. The current ratios of individual compounds from each polygon will be determined by the initial ratios determined by a field gas chromatograph (GC) upon start-up and then mass weighted based on flow from individual wells. The mass loading will be used to determine subsequent breakthrough of the secondary carbon. The carbon efficiency will also be calculated to aid in determining the carbon changeout frequency.

A total of three carbon canisters (2,000 pounds each) have been provided with the SVE system. The operational process will be to have the primary and secondary on line until breakthrough occurs in the primary canister. The flexible hose will be changed to have the secondary as the primary and to have the third canister serve as the new secondary. When breakthrough occurs in the new primary, the carbon regeneration contractor will come on-site to regenerate the two spent carbon units. The timing for the carbon regeneration will be scheduled within 48 hours after detection of primary discharge concentrations exceeding 10 ppmV as TCE in the second primary GAC bed. The maximum time for GAC bed regeneration is 14 calendar days. This procedure will ensure continuous operation and that Maricopa County air discharge regulations are not exceeded.

For GAC bed rotation, secondary carbon canister (GAC-2) should be moved to the primary position by removing the spirolite tubing from the inlet of the spent carbon canister and connecting it to GAC-2. The carbon canister (formerly GAC-2) is now designated GAC-1.

The standby carbon canister should then be connected in the position of the secondary carbon canister (GAC-2). The standby carbon canister should **NEVER** be placed into service as the primary carbon canister. The duration of SVE system shutdown for carbon bed rotation will be less than 24 hours.

Upon changing the carbon canisters, all connections should be checked. Also check that the photoionization detector sample line is correctly positioned between the primary and secondary carbon canisters and is free of leaks, kinks or other conditions which might lead to malfunction or faulty readings.

The SVE Operable Unit will be shut down for carbon replacement once two of the three GAC beds have been expended. Prior to shutdown, record the readings of all gauges and instruments. Upon shutdown, check liquid levels in the separator and condensed liquid storage tank. Check the three filters and inspect all system components. Follow start-up procedures to restart the system.

3.3.4 Vacuum Extraction Module.

Blower In-line Particulate Filter. Check the pressure drop (DPI-23) across the filter. Check the filter condition if it registers 30 inches water.

Vacuum Blower. Periodically, at least weekly monitor the vacuum blower for performance. Check inlet/outlet temperature and pressure. Note any deviations and, if not explainable from system operation, stop the system and check blower fluid levels, belt tightness and other operating characteristics, as discussed in the blower manual.

3.3.5 Electrical Control System and Power Distribution Module. These systems will be operating as necessary or the system will shut down. Monitor daily for alarm lights or indications of system problems. The following conditions will result in an alarm to the main control panel, but will not shut down the carbon system:

- High solvent inlet concentration (AE-08)

APPENDIX A

SVE OPERABLE UNIT PLANS AND SPECIFICATIONS

- High solvent exhaust concentration (AE 11)

Additionally, the following conditions will be locally indicated:

- Blower inlet pressure (PI-16)
- Blower discharge pressure (PI-20)
- Carbon discharge pressure (PI-13)
- Carbon discharge-blower inlet temperature (TI-17)
- Carbon inlet temperature (TI-15)
- Carbon inlet pressure (PI-09)
- Blower discharge temperature (TI-21)
- Differential pressure of pitot tube (FI-01, FI-14, FI-25) (flow rate)
- Condensate level in inlet vapor/liquid separator (LG-03) (sight glass)
- Differential pressure on particulate filters (DPI-22, DPI-23)
- Water level in condensate storage tank (LG-05) (sight glass)
- Vapor/liquid separator inlet pressure (PI-02)

All components of the VES are now operational. Continue to observe the overall operation of the system for several days.

4.0 OPERATION AND MAINTENANCE

Normal operation of the VES is continuous and fully automatic. However, manual process air stream sampling and manual adjusting of the air blending valve is required.

4.1 Extraction Wells

See Section 6 for Extraction well operation.

4.2 Vapor Inlet System

Some of the components of the vapor inlet system will require regular maintenance.

Clean-outs along the vapor conveyance piping system will require maintenance, including periodic cleaning of condensation and debris. Clean-outs should be inspected on a daily to weekly basis. All liquids will be treated through the Subunit A air stripper system.

FE/FT-07 will require maintenance, including periodic calibration and cleaning. M&E recommends that the instrument be checked during operation by comparison with **FE/FI-01, FE/FI-25** and **FE/FI-14**. Operation of the system without dilution air should result in essentially the same flow reading at each of these locations, adjusted to standard conditions. If differences are noted, the system should be checked for the reason, eg leakages, especially via the dilution air valve (BFV-01). If no apparent cause for different readings is noted, the one flow instrument most different from the other three should be calibrated.

Photoionization Detector Sample Line (AE-08 and AE-11) should be inspected for dirt buildup and replaced as necessary. The in-line filter should be visually inspected and cleaned or replaced as necessary. Performance of the analyzer should be referenced by whole air samples collected from vapor sample ports VS-45 and VS-42. Whole air samples should be analyzed using a hand-held vapor analyzer calibrated to the 460 ppmV TCE standard.

Level Control Switches LSL-03, LSH-03, LSHH-03 and LSHH-05 should be inspected monthly. Switch mechanisms, terminals and connections should be inspected monthly or if switch malfunction is noted or suspected. Check for brittle or bare wiring and loose screws.

Basket Strainer and In-line Filter require periodic inspection and, if necessary cleaning. Inspect and clean each whenever the condensed liquid storage tank is emptied.

Separator Drain Pump (P-1) maintenance will consist of periodic inspection and lubrication. Inspect the pump each time the condensed liquid storage tank is drained and annually. Follow the procedures in Appendix B, AFS O&M Manual, Section 2, Tab 7. Inspect the pump motor whenever the pump is inspected.

Vacuum Filters for the air blending station, the carbon in-line particulate filter and the blower in-line particulate filter should be inspected quarterly or if the pressure drop across the differential pressure indicators approaches 10 inches water gauge.

Vacuum/Pressure Gauges manufactured by Dwyer do not require lubrication or periodic servicing. Face plates should be cleaned monthly. Annually, each gauge should be disconnected and re-zeroed. If a gauge appears to be malfunctioning or giving erroneous readings, it should be recalibrated with a manometer or a known properly calibrated secondary gauge.

Explosion Proof Switches (FSL-01) manufactured by Dwyer do not require lubrication or periodic servicing. The switch should be cleaned monthly. Annually, each switch should be vented to the atmosphere by rotating the vent drain plug one turn clockwise, then returned to its original position, to dislodge deposits.

Differential Pressure Gauges (DPI-22 and DPI-23) manufactured by Dwyer do not require lubrication or periodic servicing. Face plates should be cleaned monthly. Annually, each gauge should be disconnected and re-zeroed. If a gauge appears to be malfunctioning or giving erroneous readings, it should be recalibrated as described in Appendix B, AFS Manual, Section 2, Tab 11.

4.3 Vapor Treatment System

The Carbon Adsorption system has been designed for continuous operation and has very few moving parts. However, maintaining the system in proper operating condition with periodic scheduled maintenance is of utmost importance to the safe and efficient operation of the system. Estimation of the carbon life will be made based upon predicted carbon loading efficiency, and SLA flow rates and concentrations. This calculation is verified in the field with the continuous PID monitor located between the primary and secondary GAC beds.

The activated carbon will have a finite period of effective use. However, this lifetime is dependent on field conditions and cannot accurately be predicted. Metcalf & Eddy and a qualified activated carbon regeneration contractor will evaluate when the carbon should be replaced.

Carbon Canisters should be inspected each time the system is shut down, including when carbon canisters are changed out. The general canister appearance and paint condition should be noted. Spirolite tubing connections on the canisters should be observed for cracks.

Spent Carbon will be handled by a licensed carbon or adsorption media contractor or vendor. Spent carbon will be regenerated at an EPA-licensed facility which is approved to accept Superfund-derived wastes. Facilities meeting these criteria are identified in Appendix H. Waste profile data and a sample uniform hazardous waste manifest completed with Goodyear's generator information is also provided in Appendix H.

Spirolite Tubing should be checked for cracks and kinking. Chafing at the connecting ends should be monitored, and corrected by cutting off the ends by 6 inches or so, as necessary. Tubing should be replaced if it appears faulty.

Vacuum Relief Valves (PRV-1 and PRV-2) should be observed for condition whenever the carbon canisters are changed. During carbon canister replacement, the location of the vacuum relief valves should be noted and care should be taken to keep them away from obstructions or obstacles which might affect function. The relief valves should be located such that, if actuated when personnel are present, such personnel would not be endangered.

4.4 Vacuum Extraction Module

The vacuum extraction module contains the extraction blower, along with necessary instrumentation and safeguards to provide reliable motive force to extract the solvent vapors.

Sound Enclosure and Skid is provided for noise reduction. The metal components should be observed for paint integrity and touched up as necessary. Bolts, rivets and other fasteners should be visually observed and, if loose, tightened or replaced. The blower and motor can cause vibration. Welds and joints should be inspected. A visual inspection should be conducted whenever personnel enter the treatment area, with a more thorough inspection conducted annually.

Extraction Blower and Motor maintenance includes checking and changing the oil, making sure the bearings and timing gear are properly lubricated, and maintaining proper drive belt tension. Indications of potential blower trouble include lack of performance, unusual noises, leaking oil, over heating and failing bearings and/or gears. Oil should be changed every 250 to 1000 hours of operation. Initially, lubrication should be checked daily, until it is established that the self-lubrication function of the blower is operating correctly. Then lubrication and belt tightness shall be checked each time the system is shut down, including during oil changes. For more detailed maintenance information, see Appendix B, AFS O&M Manual, Section 4, Tab 9.

Temperature Transmitter and Gauge (TE-17, TI-17, TT-17) can be calibrated from the front of the unit. This unit is self diagnostic and requires no regular maintenance. Cleaning and inspection for damaged connector wires or other conditions which might affect function should be conducted annually or if a malfunction is suspected.

Expansion Joints should be visually observed each time the system is shut down. The condition of the rubber and retaining rings should be noted. The expansion joints should be replaced if cracking or leaks are observed.

Discharge Silencer should be visually observed each time the system is down and carefully examined for corrosion and defects annually.

Sump and Stack should be visually observed each time the system is down and carefully examined for corrosion and defects annually. The flapper on the stack should be observed both during periods of system operation and inactivity. Defects to the paint, flapper operation or stack supports should be repaired.

The sump should be drained if liquid is observed collected in it. The collected liquid is likely to be rainwater, since the carbon canisters would remove solvents. All collected sump liquids and condensed liquid from the vapor/liquid separator will be disposed of by transferring water into the 240-gallon liquid storage tank for input into the Subunit A groundwater air stripping plant located at the southern portion of the site. Since all SVE liquids will be treated using the air stripping plant, no analyses of liquids will be necessary.

4.5 Electrical Control System and Power Distribution Module

Telemetry and Control consist of the **Telemetry Cabinet, Control Microsystems TeleSAFE 6000, HNu Photoionization Detector and Supporting Electronics.** Maintenance activities are to keep the telemetry cabinet clean, to make sure wires and connections are in good condition and to keep the HNu calibrated on a weekly basis. The HNu requires weekly lamp and filter cleaning, as instructed in Appendix B, the AFS O&M Manual, Section 5, Tab 11.

4.6 Sampling

Air sampling of system inlet, primary carbon discharge (breakthrough) and outlet streams and analysis with an on-site gas chromatograph is conducted during start-up to insure proper system operation. System sample ports include wellfield influent (VS-45), primary carbon inlet (VS-41), secondary carbon inlet (VS-42), and secondary carbon outlet (VS-43). During system operation, calibration of the HNu PID is conducted in accordance with the manufacturer's recommended schedule and methodology using a 460 ppmV TCE gaseous standard. The PID continuously monitors breakthrough of the primary carbon, and a secondary carbon is provided to guard against atmospheric discharge of solvent vapors. This monitoring satisfies Maricopa County Air Pollution Control District requirements for discharge sampling and monitoring.

4.7 Components of VES On-Line

Based on the results of laboratory gas chromatograph sampling, it will be necessary for the operators to determine which components of the VES should remain on-line. It is anticipated that when new extraction wells are brought on-line, a high concentration of solvent vapors will exist in the SLA.

4.8 Personnel Safety

Each component of the vapor extraction system has been designed with safety features for the protection of operating personnel. Still, certain precautions must be taken by operating personnel and a thorough knowledge of potential dangers is required. A general SVE operations Health and Safety (H&S) Plan is contained in the November 25, 1992 SVE Final Design Document, Appendix G. This section outlines these potential dangers and precautionary procedures.

4.8.1 Hearing Protection. The extraction blower will generate in excess of 75 dB noise at 3 feet distance while in operation with the doors open. Since exposure to noise of this dB level can be harmful to humans, hearing protection is required for all personnel within a 25 ft radius of the extraction blower.

4.8.2 National Electric Code (NEC) Area Classification. During operation of the VES, the hydrocarbon-laden airstream is blended with ambient air in order to reduce the hydrocarbon content to no more than 25 percent of the lower explosion limit. Therefore, the majority of the area of the VES is not classified as hazardous.

The carbon vessels are an area in which flammable gasses are stored and handled. As a result, the area defined by a 20 ft limit around the carbon units has been designated a Class 1, Division 2 area as defined by the N.E.C. Equipment within this area must be rated for operation within a Class 1, Division 2 area and all other precautions appropriate to working within such an area must be taken by operating personnel.

4.8.3 Guards. All mechanical equipment with motion that may be hazardous to operating personnel must be guarded. This includes all couplings, belts, gears, sprockets, etc. Guarding shall be in compliance with OSHA standards.

4.8.4 Electrical. The installation of all electrical components, wiring, etc. must be in accordance with the N.E.C. and applicable state, county, and local building codes.

Electrical cabinets, instrumentation consoles and enclosures should be operated in the closed and sealed position. Hazards from exposed open electrical cabinets are not considered to be significant under normal operating conditions, however, conditions may change providing a potentially dangerous mixture of air and fuel in close proximity to the VES system. By keeping all electrical cabinets and instrumentation consoles closed and sealed, a potential source of ignition is eliminated. Only authorized personnel may work on these enclosures.

4.8.5 Special Safety Precautions. The equipment manuals for the extraction blower system, the Carbon adsorption system, and the vapor/liquid separator contain safety precautions, safety features and warnings unique to each component. The equipment manuals must be read thoroughly and fully understood by operating personnel prior to system start-up.

4.8.6 Extraction Wells. Special precaution should be taken whenever working on extraction wells which are located throughout the subarea, including traffic areas. Refer to Section 4.2.5 of the H&S Plan (Appendix G of the May 13, 1994 SVE Final Design Document) for a description of equipment operation hazards.

4.8.7 Relief Valves. Relief valves are designed to prevent structural failure of vessels and piping systems on the VES system and shall remain in service during operation of the VES equipment. At no time shall the VES relief equipment be blocked-in, removed, or operated in a known failed or damaged condition. Since many of the major components of the VES system operate under vacuum, relief devices will relieve vacuum by opening the vessel or piping system to the atmosphere. The relief device will be activated by sensing an excessive pre-determined setting of vacuum which will open the valve mechanism.

Obstructions near the open relief ports pose a particular hazard. In the unlikely event of a relief, obstructions in close proximity to the open relief ports could interfere with the effectiveness of the relief valve. Workers could also be exposed to a significant hazard if hands, fingers, head or other extremities are in close proximity to the open port. Be advised: keep away from the vacuum relief ports.

4.8.8 Warning Signs. The following warning signs will be provided, assuming the following site conditions:

- The vapor extraction equipment will be in an enclosed area secured by a chain link fence.
- The equipment will not be subject to passers-by entering the enclosure.
- The general area has a relatively large number of Spanish only speaking residents.
- The cautions and dangers indicated below are recommended to satisfy State and local regulations as well as EPA expectations outlined in the Health & Safety Plan.

Treatment Area Hazard Signs/Warnings:

1. 2-each 11 x 19 Alum.

<u>DANGER</u>

HAZARDOUS AREA
DO NOT ENTER

<u>PELEGRO</u>

AREA PELIGROSA
NO ENTRE

2. 2-each 11 x 19 Alum.

<u>KEEP OUT</u>

AUTHORIZED PERSONNEL ONLY

<u>PROHIBIDO EL PASO</u>

SOLAMENTE PERSONAL AUTHORIZADO

3. 2-each 11 x 19 Alum.

<u>NO SMOKING</u>

<u>PROHIBIDO FUMAR</u>

4. 1-each Hazard Area I.D. Kit

<u>DANGER</u>

Hazard Area
I.D. Kit

Contains 35 stick-on warnings and admittance authorization information signs.

USE: CAUTION, Keep out, Toxic Chemicals, High Voltage and Admittance to Authorized Personnel Only.

5. 1-each 9 x 12 Alum.

<u>DANGER</u>

THIS EQUIPMENT
STARTS AUTOMATICALLY

6. 1-each 6.5 x 11	NFPA - Diamond for fence mounting near the facility entrance
7. 1-each, 9 x 12 Alum.	<u>DANGER</u> HIGH VOLTAGE KEEP OUT
8. 1-each 9 x 12 Alum.	<u>CAUTION</u> NOISE AREA
9. 1-each 9 x 12 Alum.	<u>CAUTION</u> **HOT**
10. 1-each 11 x 19 Alum.	<u>DANGER</u> FLAMMABLE ---------- INFLAMABLE

5.0 SVE SUB-AREA/WELL OPERATION AND MAINTENANCE MANUAL: INTRODUCTION

This SVE extraction and monitoring well O&M plan has been updated by addendum to provide the basis of sub-area operation, rebound monitoring, and closure activities at Polygons 96/92/27A. Five polygons were selected and prioritized for SVE remedy based on the final site-wide modeling completed in October 1993. The five polygons included 96, 79, 92, 27A and 84 in decreasing prioritization. SVE remedy has been completed at Polygons 79 and 84. Polygon 84 was prioritized over the remaining polygons because of its proximity to Polygon 79, which allowed treatment without relocating the SVE treatment system. The SVE treatment system has been relocated for treatment of Polygons 96/92/27A. The remaining polygons are located in proximity to one another and will be treated in order of decreasing priority via a common treatment system location. Within each polygon, sub-areas will be treated in order of decreasing contamination.

Due to the lack of current polygon or sub-area specific data, the O&M plan addendum is in draft form, and addresses the basis for and protocols of operation and monitoring. During SVE operable unit start-up, Goodyear will develop the polygon or sub-area specific values of parameters needed for operation, monitoring, and closure.

The final operation and maintenance parameters will be submitted to U.S. EPA no later than 60 days following start-up of the SVE system (1990 Consent Decree, Section VII, Subsection D-14, p. 22) if U.S. EPA comments warrant a document revision. The Final SVE O&M addendum to U.S. EPA will be under one cover entitled, "Phoenix-Goodyear Airport Soil Vapor Extraction Operable Unit Operation and Maintenance Manual, Polygons 96/92/27A." This draft addendum provides the basis and decision criteria for sub-area remediation and closure. The following sections present the updated Well Operation and Maintenance Plan for the sub-areas of Polygons 96/92/27A.

6.0 START-UP AND ON-GOING OPERATIONS AND MAINTENANCE (O&M) PLAN

This section describes the methodologies that will be employed during start-up and on-going operations for a typical sub-area extraction well. As defined in Section 5 of the May, 1992 SVE Design Memorandum, the first extraction well to be operated in a given polygon will be the well which is located in the most highly contaminated sub-area of that polygon based on the results of pre-startup field sampling. The location of the sub-area extraction wells are indicated on Drawing 96-C-1 and 96-C-2, Appendix A of this document. All of the SVE extraction wells required to treat each polygon will be operated in a manner that is consistent with Appendix B of the 1990 Consent Decree.

Historic work conducted at the PGA site has generated data regarding subsurface SVE Operable Unit conditions (Remedial Investigation Report, U.S. EPA, and Appendices of the 1989 RI/FS). However, because subsurface conditions are variable across the site, an initial soil vapor baseline sampling/analytical event will be completed. At the onset of SVE start-up for each polygon, soil vapor samples will be collected and analyzed using a field GC from each monitoring well/piezometer. For baseline monitoring well sampling locations in each polygon, see Drawing 96-C-1 and 96-C-2, Appendix A. The results of this baseline sampling will establish current soil vapor concentrations at various locations throughout each polygon, establish the current vertical distribution of VOC contamination in each sub-area, determine the initial composition of the vapors to be used in evaluating carbon loading efficiency, and serve as a starting point on which to base SVE remedial progress. In addition to baseline soil vapor sampling, sub-area specific subsurface parameters existing in the field will be developed during start-up to optimize SVE system operation and maximize the system efficiency.

A total of eleven SVE operating elements have been established to confirm system operational performance, track remediation progress and maximize system efficiency and to facilitate sub-area closure assessment. The eleven elements include:

1. Extraction/monitoring wellhead vacuum and flow rate measurement
2. Radius of soil vacuum influence measurement and modeling
3. Air permeability calculations for soils occurring within the radius of influence
4. Radial soil vapor velocity calculations

5. Soil vapor flow field evaluation
6. Soil vapor contaminant composition and concentration
7. Critical flow/vacuum rate determination
8. Extraction well efficiency calculation
9. Sub-area remediation duration modeling
10. SVE extraction well rebound monitoring
11. SVE sub-area Allowable Residual Mass (ARM) assessment for closure

On-going SVE Well Maintenance will include:

1. Field monitoring instrument calibration and cleaning
2. Wellhead inspection and valve control/adjustment

Measurement and/or calculations of the eleven elements (1 through 11) will be carried out over the course of Sub-area SVE Remedy as described in the following sections. Development of the protocols associated with each element are discussed in greater detail in the following sections of this report. On-going SVE wellhead operation is discussed in detail in the following sections of this Operation and Maintenance Manual. Field monitoring instrumentation calibration and cleaning is discussed in the SVE Operation and Maintenance Quality Assurance Project Plan, Appendix D, and are the same protocols used in the May 13, 1994, SVE Final Design QAPP.

Efficient operation and maintenance of the SVE extraction well network for sub-area and polygon treatment will require the collection of operational data for performance analysis. The operational data will be collected in a manner that will facilitate sub-area prioritization for treatment and monitoring to minimize the overall polygon remediation time frame. Data will be collected frequently upon polygon SVE start-up to establish the parameters necessary for continuous system operation. Models will be used as necessary to predict milestone achievement and to minimize on-site monitoring efforts. The predictive models will be adjusted as operational data becomes available. The SVE operational data will be collected as necessary to document remediation progress from start-up, through operation, rebound, and closure sampling.

The first extraction well will be operated during start-up for a period of time under both constant and variable flow rates and vacuums to permit measurement/calculation of the first nine of the eleven elements. The parameters will be measured as required in the 1990 Consent Decree, Section VII, Subsection C-6, and in addition will provide well operation information that will maximize operational efficiency and reduce sub-area clean up times. Measurement and/or calculations of the eleven elements will be carried out as discussed below (also see May 13, 1994 SVE Final Design, Appendix H, QAPP). Once the parameters have been developed for the first well, or sub-area, the other wells in a given polygon will be brought on line for SVE operation.

6.1 Extraction/Monitoring Well Vacuum and Flow Rate

At selected periods throughout on-going SVE operations at the first extraction well, the vacuum differential, and soil vapor flow rate parameters will be directly measured from the SVE extraction well and SVE monitoring well(s).

Vacuum drawdown will be measured at the wellhead during SVE operation using a liquid filled U-tube manometer sensitive to differential pressures as low as 0.05 inches of water. The vacuum drawdown port will be located at the same location of the temperature probe port at each wellhead.

Soil vapor flow rate measurements will be taken during SVE operations using a Magnehelic differential pressure gauge or liquid-filled U-tube manometer mounted to an orifice plate differential flow indicator. The differential pressure indicator will be located 4 to 6 inches upstream of the temperature and vacuum ports, a location where air flow is laminar, without turbulence which might be caused by potential blockages in the wellhead. Differential pressures will be recorded in units of inches of water column (in H_2O). Standardized units of flow (SCFM) will be calculated using the flow, pressure and temperature data collected and the following equation:

Orifice Plate Flow Calculation Equation:

$$Q_1 = \frac{Q_2}{\sqrt{\frac{h_2}{h_1}}}$$

where:

Q_1	=	Flow (ft^3/min standard)
Q_2	=	Maximum flow constant for orifice plate element calculation constant (ft^3/min standard)
h_1	=	Measured differential pressure (in H_2O)
h_2	=	Differential pressure at Q_2 maximum flow constant (in H_2O)

Note:

Each orifice plate has a unique flow element calculation sheet and Q_2 and h_2 values. See Appendix C for the orifice plate flow element calculation sheets and constants.

A field data log sheet similar to that shown in Figure 6-1 will be filled out during the start-up testing and used to calculated in-situ vadose zone parameters.

6.2 Radius of Soil Vacuum Influence (R_I)

The radius of soil vacuum influence (R_I), by definition, is that area or volume of unsaturated soil matrix surrounding a soil vapor extraction well that exhibits a measurable vacuum when the extraction well is exerting a vacuum on the soil matrix. For the site, the measurable limit is defined as greater than 0.1 inch H_2O vacuum.

In accordance with the site Record of Decision (ROD), Polygon 79 contained a total of four sub-areas, and therefore, a total of four extraction/monitoring well pairs. The number of sub-areas for each polygon was calculated from the RI/FS data. Operation of the SVE system in Polygon 79 (see Figure 6-2) revealed that the sub-area design radius of influence of 100 feet was conservative and

FIGURE 6-1
Phoenix-Goodyear Airport
SVE Well Monitoring Log

DATE: ________________ ENGINEER: ________________________________

PID FIELD INSTRUMENT: __________________ PID INSTRUMENT CALIBRATION GAS & CONC.: __________________ (ppmV)

TCE SPAN GAS CONCENTRATION: ________________ (ppmV)

Well / Depth	Sample Time	Analysis Time	PID Calibration Time	TCE Conc. (ppmV)	PID Baseline (ppmV)	Sample conc. (ppmV)	Well Pressure (" H_2O)	Flow ΔP (" H_2O)	Purge Time (min)	Oxygen Baseline (%)	Oxygen (%)	CO_2 (%)	Comments
VP96-1A													
VP96-1B													
VP96-2													

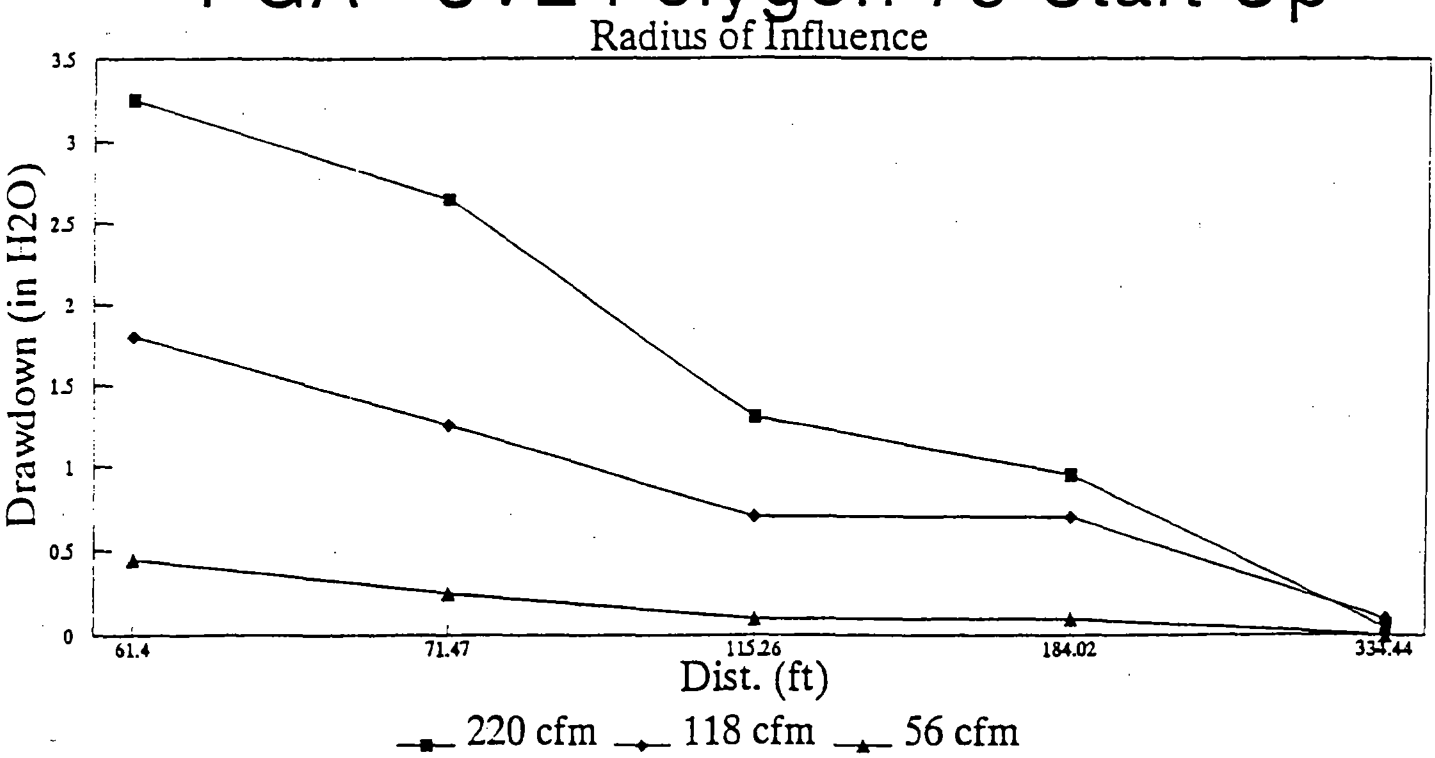
Well / Depth	Sample Time	Analysis Time	PID Calibration Time	TCE Conc. (ppmV)	PID Baseline (ppmV)	Sample conc. (ppmV)	Well Pressure (" H_2O)	Flow ΔP (" H_2O)	Purge Time (min)	Oxygen Baseline (%)	Oxygen (%)	CO_2 (%)	Comments
VP96-3													
VP92-1													
VP92-2													
VP92-3													

Well / Depth	Sample Time	Analysis Time	PID Calibration Time	TCE Conc. (ppmV)	PID Baseline (ppmV)	Sample conc. (ppmV)	Well Pressure (" H_2O)	Flow ΔP (" H_2O)	Purge Time (min)	Oxygen Baseline (%)	Oxygen (%)	CO_2 (%)	Comments
VP27A-1													
VP27A-2													
VEW96-1													
VEW96-2													
VE96-3													
VEW92-1													
VEW92-2													
VEW92-3													
VEW27A-1													

Phoenix-Goodyear Airport
Polygon 79 SVE Operations
Extraction Well VEW-79-4 On
October, 1993
(SPZ-10/15/93-VAC1.WK3)

Flow cfm		220	118	56
Distance from	Distance (ft)	Vacuum (50) (in H2O)		
VP-79	61.4	3.25	1.8	0.45
VP-79-4	71.47	2.65	1.25	0.25
VP-79-3	115.26	1.3	0.7	0.1
VP-79-1	184.02	0.95	0.7	0.1
VP-79-2	334.44	0.05	0.1	0

PGA-SVE Polygon 79 Start Up



METCALF & EDDY

POLYGON 79 START UP

FIGURE 6-2

that a design radius of 150 feet can be used for subsequent polygon designs. Based on this, Polygons 96, 92 and 27A contain three, three, and one subarea(s), respectively.

Based on Polygon 79 vacuum decay over distance data, the sub-area monitoring wells for Polygons 96/92/27A have been placed approximately 80 to 100 feet radially from the extraction well. These wells will be used for radius of influence monitoring as well as sub-area compliance sampling for VLEACH modeling for closure.

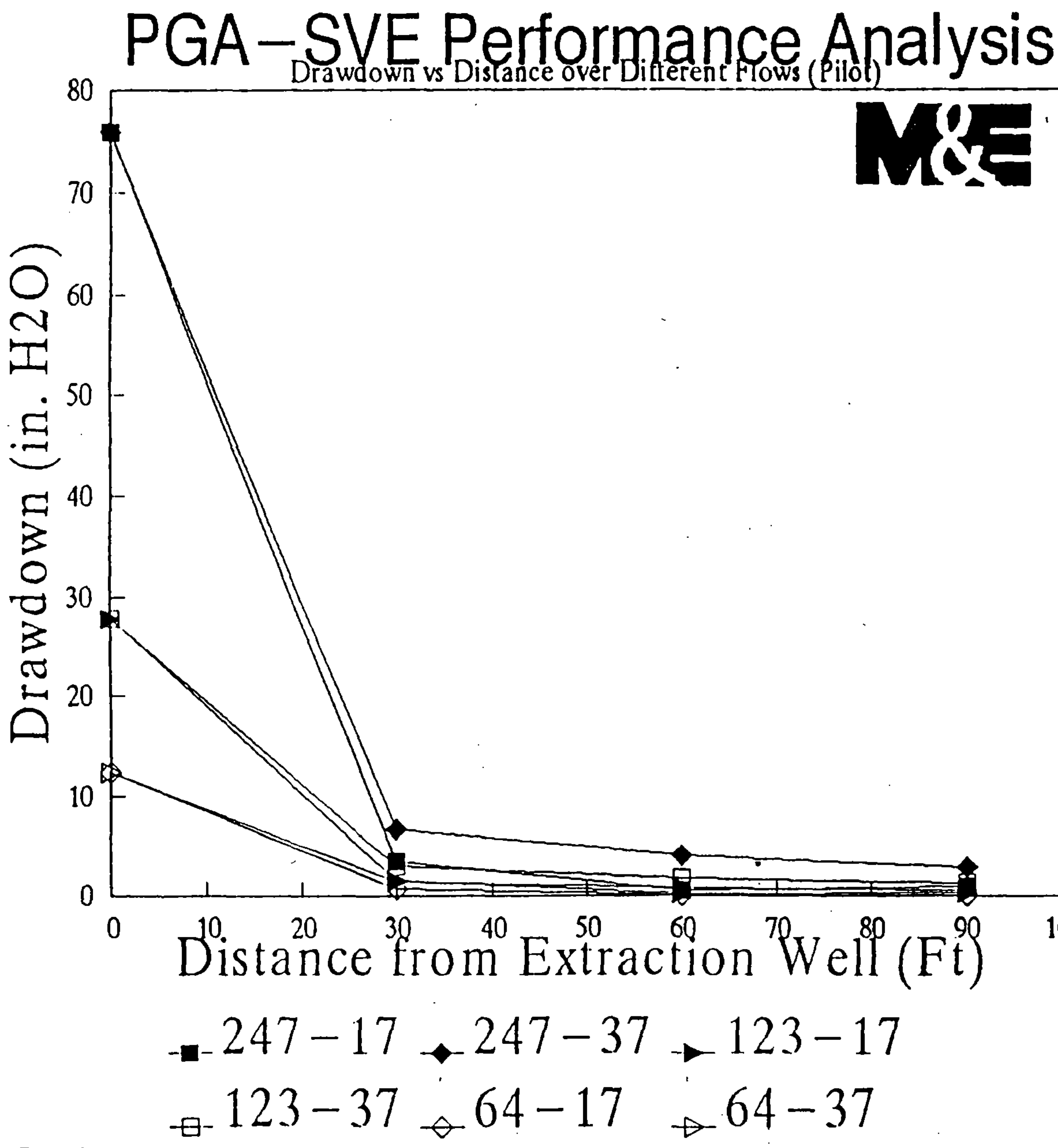
Drawings 96-C-1 and 96-C-2 (Appendix A) illustrate the location of the extraction and monitoring wells. Drawing 96-M-2, Detail 11 shows a typical vapor extraction well detail, and Drawing 96-M-4, Detail 4 shows the vadose zone monitoring well detail. On Drawing 96-C-1 and 96-C-2, vapor extraction wells have the designation VEW while the vadose zone monitoring wells have the designation VP. During the start-up testing, vacuum differential measurements recorded as described in Section 6.1 will be plotted as vacuum drawdown versus distance from the SVE extraction well at several SVE system flow rates similar to the plot shown in Figure 6-3. The maximum R_I value will be defined as the distance from the extraction well where the vacuum in the vadose zone measured from a monitoring well is greater than 0.1 inches of water (twice the minimum operational range of the manometer). The vacuum limit of 0.1 inch of water was selected to minimize interference from atmospheric pressure changes during parameter measurement. A vadose zone monitoring well outside the zone of well influence will be monitored for vadose zone pressures resulting from barometric pressure changes during system start-up and operation. Two methods will be used for evaluating the true radius of extraction well influence. The first method will be strictly numerical, using the equations and methods of Johnson, et al. (1988). The equations that will be used include:

$$Pr = Pw\ [1+(1-\left(\frac{Patm}{Pw}\right)^2)\ \ln\left(\frac{r}{Rw}\right)/\ln\left(\frac{Rw}{R_I}\right)]^1/2$$

Equation 6-1

Where:

Pw	=	Pressure at extraction well
Pr	=	Pressure at distance r
Rw	=	Well borehole radius
Patm	=	Atmospheric pressure



Pilot Measurements at 17' and 37' BGS at each location except extraction well.
Three Extraction Flow Rates-247, 123, 64 SCFM

METCALF & EDDY	SVE PERFORMANCE	FIGURE 6-3

and,

$$Q = 2\pi r_w U(r_w) H = H(\pi k/\mu) P_w [1-(Patm/P_w)^2] / \ln\left(\frac{R_w}{r_I}\right)$$

Equation 6-2

Where:

H	=	Length of extraction well screen (vadose zone)
Q	=	Vapor flow rate
U	=	Radial darcian velocity of vapor
μ	=	Viscosity of soil vapor (0.018 cp)
k	=	Air permeability of soil

A simplified model of extraction well flow rates and applied wellhead vacuums has been developed from the Polygon 79 pilot test data. A plot of the pilot test data reveals that the relationship between the two parameters is linear to log normal over the test range (see Figure 6-4). Since the best fit curve to the data was linear, the equation of the line is:

$$P_{vew} = 0.37187Q + -14.88116$$

Equation 6-3

Where:

P_{vew}	=	Vacuum (in H_2O)
Q	=	Flow (SCFM)

These equations will be used to numerically evaluate data collected from the extraction and monitoring wells and optimize system performance.

A second analytical method that may be used to evaluate spatial variations in vapor flow as a result of the layered vadose zone will be a multi-dimensional computer flow model (Struttmann and Zachary, 1993). This computer model may be used to evaluate well optimization flow rates based on vadose zone boundary conditions such as the capillary fringe, upper-fine vadose zone, or paved surfaces. If used, the model will be calibrated using the vacuum versus distance values collected from the sub-area monitoring wells. Model documentation is provided in Appendix E.

PGA–SVE Performance Analysis

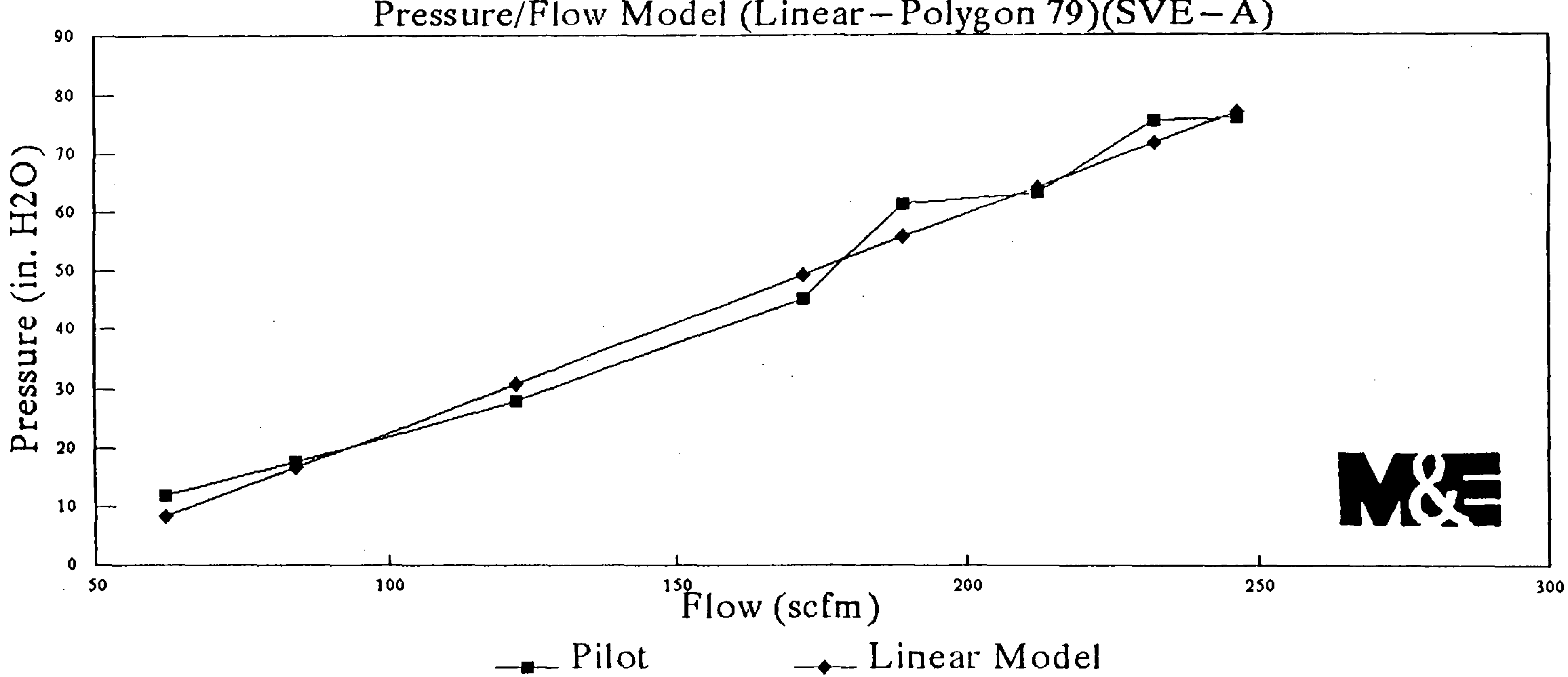


Figure 4

The procedure to calculate the radius of influence is described below. The first step is to collect the pressure and flow data from the extraction well and the nearby observation well. The steady-state radial gas flow equation is as follows:

$$(P_2)^2 - (P_1)^2 = \frac{Qm\mu RT}{\pi wKH} \ln\left(\frac{r_2}{r_1}\right)$$

Equation 6-4

Where:

P	=	Pressure measured at a well
r	=	Distance from extraction well center
Qm	=	Mass flow rate of the extraction well
R	=	Universal gas constant
T	=	Air temperature in Kelvin
w	=	Molecular weight of air
H	=	Formation thickness

The equation can be resolved in terms of pressures and distances with a constant that is a function of air flow rate, air viscosity, temperature, molecular weight of the gas, permeability of the soil and formation thickness. These parameters are difficult to determine individually without a constant rate pilot test. However, recognizing that for a given flow rate this term can be resolved into a constant, the gas flow equation is simplified to:

$$(P_2)^2 - (P_1)^2 = QmB \ln\left(\frac{r_2}{r_1}\right)$$

Equation 6-5

Where:

$$B = \frac{\mu RT}{\pi wKH}$$

Given the data collected at a known flow rate, the constant can be calculated. The next step is to use the pressure (P_1) at a distance (R_1) and the mass flow rate (Qm); input (P_2) as atmospheric pressure less a drawdown of 0.1 inches water vacuum; and solve for the radius of influence (R_I).

After calculating the influence of wells operated individually, the next step in the evaluation is to account for the interaction of multiple operating wells that have overlapping radii of influence. The second level of determining radius of influence and interaction between wells is to use a finite difference ground water flow model adapted for soil vapor flow (Struttmann and Zachary, 1993, see Appendix E) to determine the resulting pressure surfaces in three dimensions. The model will be calibrated with the data collected from the extraction wells and the nearby piezometers. The objective of the modeling will be to predict the influence of the different extraction rates and resulting "stagnation" areas between two extraction wells. Additionally, the model may be used to aid in determining the radial soil vapor velocities (see Section 6.4).

Following operation of the system, after the first extraction well is below the site remediation level, computer flow modeling may be conducted to evaluate the desired adjustments of the remaining extraction wells. The objective is to accelerate the cleanup of a given polygon and to not leave "pockets" of contamination behind.

Results of the numerical and analytical evaluation will provide data for system operation optimization. Flow rates and extraction well vacuums will be adjusted to achieve the desired area of well influence and associated sweeping zones. The analysis will be performed on each sub-area as needed once it has been placed in service. Adjustments will be made to the sub-area operational conditions based on the results of the analysis. Field data, computer simulations and calculation results will be provided to the U.S. EPA in Goodyear's monthly report.

6.3 Air Permeability Calculations for Soils Occurring within the R_I of Extraction Well

The air permeability parameter (k_a) will be calculated from measured field parameters collected during start-up testing. The measured parameters will be input into a darcian analog equation relating the air permeability parameter to the pressure differential(s), measured gas flow rate(s), geometry of the extraction well, and physical properties of the extracted gas (density, viscosity, etc.).

The magnitude of the air permeability will reflect native soil pore water conditions as well as soil texture. As SVE operation continues, it is anticipated that a decrease in the water content will give rise to increasing k_a values. As such, air permeability calculations will be completed following start-up testing and at the initiation of the rebound period. These values will assist in optimizing system operation. Results of the air permeability calculations will be included in Goodyear's monthly report to U.S. EPA.

6.4 Radial Soil Vapor Velocity

Based on the calculated air permeability parameter from the pilot test or operating sub-area, the radial soil vapor velocity may be calculated having knowledge of differential pressures using a modified darcian equation (see Equation 6-2). Radial soil vapor velocity determination will allow M&E to evaluate radial sweeping efficiencies of the SVE system as a function of both soil type and applied differential pressure. The radial soil vapor velocity, being largely controlled by the applied vacuum across a well of given diameter, will be optimized through manipulation of the applied vacuum across SVE extraction wells during SVE operation.

The soil vapor velocity varies inverse exponentially with the distance from the extraction well. Using this radial flow relationship, soil vapor travel times can be calculated to determine the length of time to flush a vapor pore volume from the area being remediated. The radial vapor velocity and corresponding travel times, once evaluated, will be used to calculate the number of pore volumes of vadose zone vapor that will be required to achieve a desired remediation level that satisfies the conditions of Appendix B of the 1990 Consent Decree. Section 6.10 describes the sub-area remediation time in greater detail. Results of the radial soil vapor velocity calculation, if performed, will be included in Goodyear's monthly report to U.S. EPA.

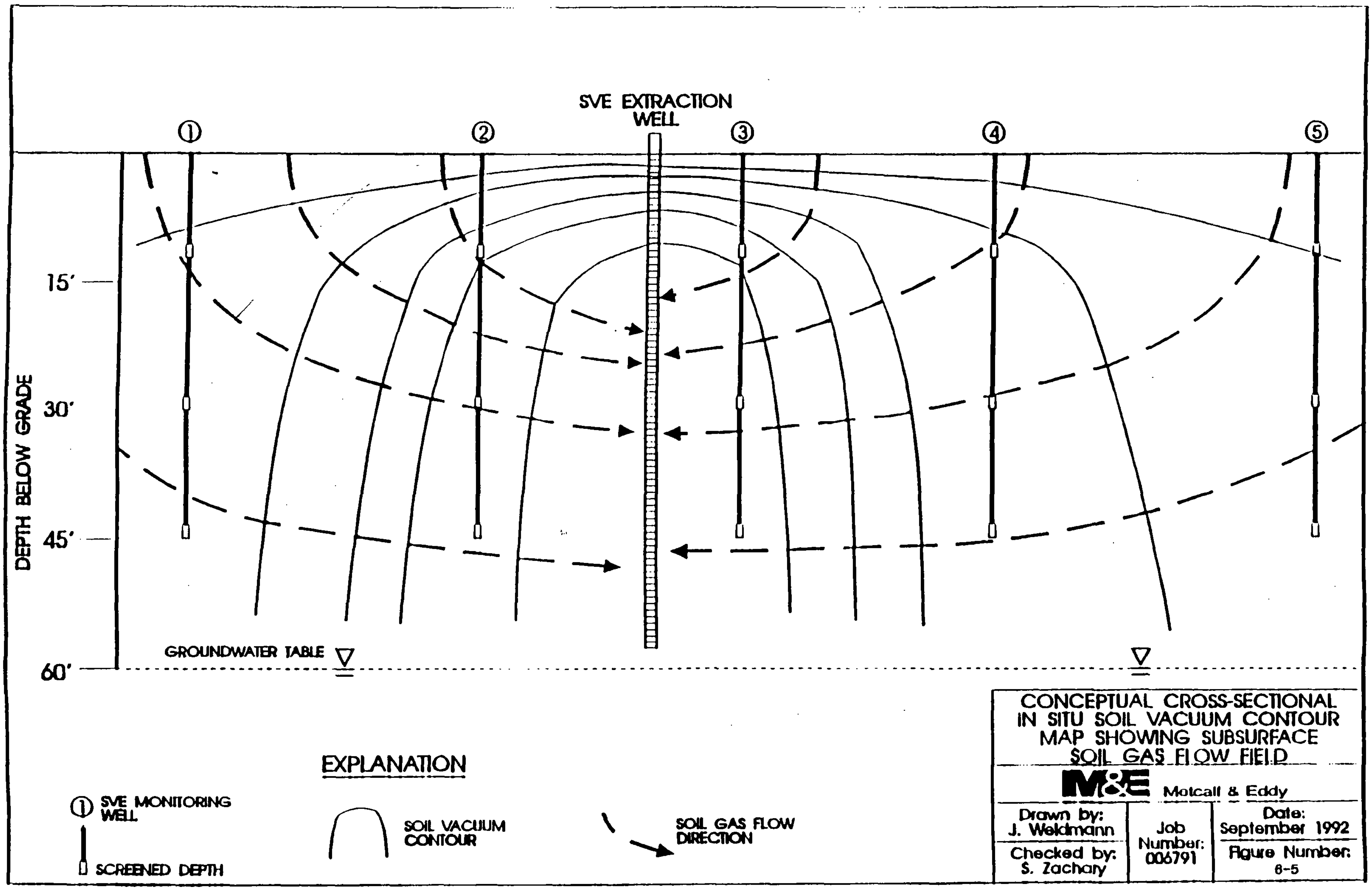
6.5 Soil Vapor Flow Field Determination

Based on the vacuum drawdown records established during start-up operations, soil vapor flow fields will be constructed to evaluate the nature of subsurface advective soil vapor flow. This will prove effective when evaluating whether vapor stagnation points may exist in the subsurface during operation and for optimization of subsurface flow conditions. Construction of flow fields may also prove valuable when evaluating the conductivity of different soil types in the vadose zone to soil vapor flow.

The flow fields resulting in one or more sub-areas operating will be developed based on vacuum data collected from the sub-area monitoring wells. The vacuum data will be plotted in four layers representing the various vertical depths the individual monitoring wells are completed within. The number of plots produced will be adjusted as necessary after start-up to reflect the level of detail required for system analysis. In addition to single well influence, contoured plots will be prepared for all simultaneously operating wells to evaluate multiple well influences on the vadose zone. The vacuum data from each of the sub-areas will be contoured using the statistical software package SURFER using the kriging method. The measured flow fields will be compared to the multi-dimensional computer model results to evaluate system performance and the sub-area extraction well flow and vacuums will be adjusted to optimize the treatment zone, minimize stagnation zones, and minimize the polygon remediation time frame. Results of the sub-area and polygon vacuum plots will be included in Goodyear's monthly report to U.S. EPA, if performed. See Figure 6-5 for a conceptual representation of a soil vapor flow field diagram.

6.6 SVE Monitoring and Extraction Well Soil Vapor Sampling/Analysis

During and following start-up operations, soil vapor samples will be collected from the SVE extraction and monitoring wells for analysis in the field. Field analytical samples will be collected from SVE monitoring and extraction well headers during SVE operation in 3-liter capacity Tedlar bags using a vacuum pump connected to a vacuum sampling box and will be analyzed in the field with a GC or portable photoionization detector (PID). Because negative pressures will be present in operating SVE well headers and monitoring wells, effective soil vapor sample collection will require initially setting the vacuum sampling pump at a negative pressure greater than that measured in the well or well header. Wellhead vacuums and vacuum sampling pump settings will be recorded during each sampling event. The sampling procedures established in the May 1992 SVE Design Memorandum and associated Quality Assurance Project Plan (QAPP), Appendix D will be adhered to for all sub-area well monitoring. Sampling will commence after steady-state conditions are achieved at a given flow rate at the sampling pump. Steady-state conditions are defined as less than 10% fluctuation in the induced vacuum at the sampling flow rate of 200 ml/minute.



SVE EXTRACTION WELL
①
②
③
④
⑤
DEPTH BELOW GRADE
15'
30'
45'
60'
GROUNDWATER TABLE
EXPLANATION
① SVE MONITORING WELL
SCREENED DEPTH
SOIL VACUUM CONTOUR
SOIL GAS FLOW DIRECTION
CONCEPTUAL CROSS-SECTIONAL IN SITU SOIL VACUUM CONTOUR MAP SHOWING SUBSURFACE SOIL GAS FLOW FIELD
M&E Metcalf & Eddy
Drawn by: J. Weidmann
Checked by: S. Zachary
Job Number: 006791
Date: September 1992
Figure Number: 6-5

Following an initial baseline sample analytical event using a GC, subsequent analysis of collected soil vapor samples will be performed in the field using a portable PID instrument calibrated to a gaseous TCE standard. During rebound monitoring (Section 7.0), soil vapor samples will be analyzed in the field using the portable PID instrument. All PID field analysis will be performed using Tedlar bags to avoid erroneous PID readings as a result of instrument and sample pressure differentials. Based on the results of the field PID analysis during rebound monitoring, e.g. if the Allowable Residual Mass (ARM) (1990 Consent Decree, Appendix B) levels have been met (Section 7.0), laboratory sampling will be initiated.

Laboratory samples will be collected in pre-cleaned, passivated SUMMA canisters and forwarded to a certified laboratory for chemical analysis. The monitoring well sampling procedures detailed in the 1992 SVE Design Memorandum and associated QAPP, and Appendix D of this report will be adhered to. Each well, prior to sampling, will be purged of ambient vapor at a rate of 200 ml/minute with a mass flow controller and pump. The discharge of the pump will be monitored with a calibrated PID to monitor the concentrations of the extracted vapors. A total of two well volumes or a peak in the extracted vapor concentration during purging will dictate the total purge time. Immediately upon completion of the well purging, a laboratory cleaned SUMMA canister will be connected to the wellhead using teflon tubing and a sample will be collected. A pre-cleaned mass flow controller calibrated to 200 ml/minute will be used for sample collection to minimize equilibrium disruption.

Based on the results of VLEACH and Mixing Cell modeling of Phase II investigation vertical soil vapor distributions, a lower-threshold operational ARM concentration has been determined for each polygon to undergo SVE remedy (see Section 7.0). The on-going SVE field operations will utilize the estimated lower-threshold ARM concentration as a decision criteria of whether or not to shut off a sub-area extraction well and initiate rebound monitoring (Section 7.1). If the threshold concentration is less than 1 ppmV, a field gas chromatograph will be used for routine and field rebound well vapor monitoring (see June 1, 1995 SVE Final Design, Appendix H).

The vertical contamination distribution in Polygons 96/92/27A is "middle to bottom loaded", or concentrated in the middle to lower-coarse vadose zone. The lower-coarse vadose zone variably extends from approximately 30 to 60 feet below grade. Rising Subunit A groundwater levels have reduced the thickness of the lower-coarse vadose zone from 30 feet in 1989 to a current thickness of approximately 20 feet. The lower-coarse vadose zone matrix consists of a coarse sand to a sandy gravel with an associated air permeability of approximately 100 darcies.

Above the lower-coarse vadose zone lies the upper-fine vadose zone. This zone is characterized by sandy silts and clays with some poorly to well developed caliche layers. The permeability of the upper-fine vadose zone is approximately two orders of magnitude less than the lower-coarse, or approximately 1 to 3 darcies. The texture, moisture content, and resultant air permeability of these two zones, however, do not have a large impact on the effectiveness of SVE in removing the chlorinated solvents from the vadose zone due to soil macro-fractures that permit gas transmission between the upper-fine and lower-coarse units. The lower-coarse vadose zone, which contains the bulk of the delineated contaminants, will efficiently permit their removal due to the high air permeability of the soil matrix. Also aiding in this removal is the low permeability upper-fine vadose zone providing air impermeable boundary to air "short-circuiting" from the atmosphere. These results were confirmed by the 1988 pilot test and Polygon 84 data and verified through model simulations.

Sub-area treatment monitoring will consist of monitoring extraction and monitoring wellhead concentrations to evaluate well extraction, performance, and to evaluate sub-area operation, rebound, laboratory sampling, and confirmatory closure sampling.

All field monitoring samples will be collected using 3-liter capacity Tedlar bags within withdrawn in a negative pressure box and analyzed with a PID instrument in the field. All laboratory samples will be collected using 3 or 6-liter capacity SUMMA canisters. All sampling procedures established in the 1992 Design Memorandum and this O&M Manual QAPP (Appendix D) will be adhered to. The instrumentation specified in the QAPP (Appendix D) has been selected based on the anticipated concentrations that will be observed in the field during operation and rebound periods.

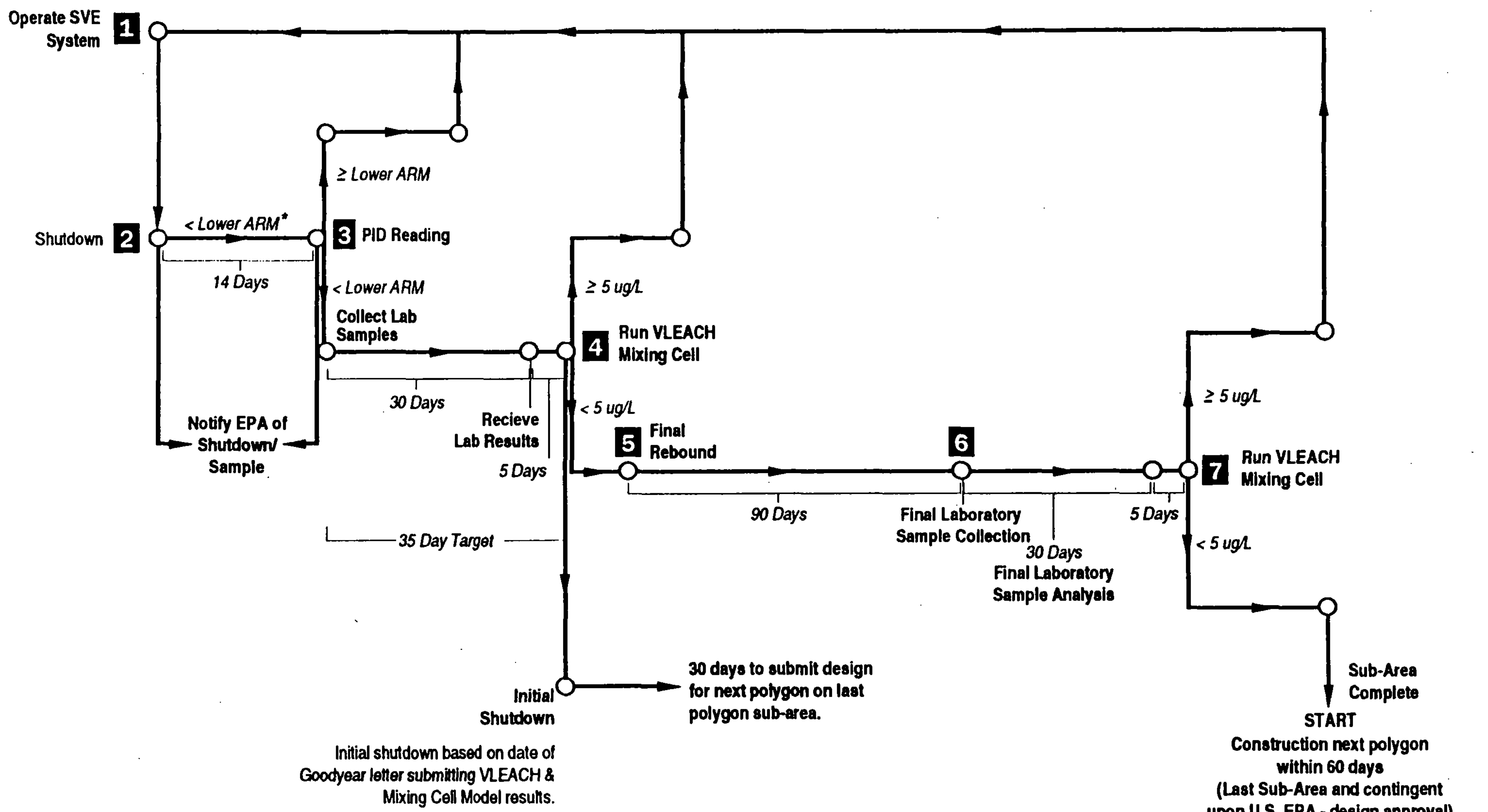
The concentrations to suspend sub-area treatment and commence rebound monitoring have been roughly established for Polygons 96/92/27A based on 1993 Phase II investigation data and are described in detail in Section 7.0.

Vapor extraction wells will be brought on line one at a time to allow for vacuum propagation throughout the sub-area and allow sufficient time for pressure and flow monitoring. Prior to bringing the extraction wells on line, the wells will be screened in the field using a GC and a portable PID to prioritize the wells for operation. The extraction well demonstrating the highest concentration will be operated first to establish the capture zone (R_I) and minimize the risks of plume migration by influence from other extraction wells.

Each extraction well will initially be operated at a flow rate of 50 SCFM. The flow rate and associated vacuum will gradually be increased while monitoring the extracted vapor concentrations and vacuum propagation in the monitoring wells. Once the design radius of influence (150 feet) has been established as observed in the monitoring wells and through calculation, additional extraction wells will be brought on line as appropriate in the same manner. Vapor extraction wells will be brought on-line in the order of decreasing concentrations. This decision will be based on the baseline vadose zone concentrations present in the sub-area monitoring wells at the time of system start-up. Additionally, wells that contain higher concentrations will be operated at higher flow rates and vacuums to minimize moving high vapor concentrations through lesser contaminated areas.

Once a sub-area is operational, vapor concentration samples will be collected from the extraction and monitoring wells on a bi-weekly basis and analyzed in the field using a portable PID instrument. Each extraction well will be operated until the concentrations in the associated sub-area monitoring well have reached the lower-ARM concentration (see Section 7.0). The lower-ARM concentration is a sub-area specific ARM concentration that takes into account the effects of VOC concentration increases during rebound. Lower-ARM concentrations presented in Section 7.0 have been established based on a rebounding factor of 4.0 using rebound performance experienced at Polygons 79 and 84. This rebounding factor is thought to be reflective of Polygons 96/92/27A conditions. However, the lower-ARM concentration and rebounding factor will be modified as appropriate to meet ARMs established in the ROD.

Once lower-ARM concentrations have been achieved, the sub-area extraction well will be shut off and the sub-area will be allowed to rebound for 14 days (see Figure 6-6). If the soil vapor concentrations rebound in the monitoring wells at the end of the 14-day period less than 20% of the initial previous start-up concentration, laboratory samples will be collected in SUMMA canisters for



* *Lower ARM* = Allowable Residual Mass with Rebound Factor using VLEACH and Mixing Cell.

SVE Rebound Verification Flow Chart

Phoenix-Goodyear Airport
Soil Vapor Extraction
012014

Figure 6-6

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analysis. If the concentrations rebound greater than 20% of the initial or restart concentration, whichever is most recent, the sub-area extraction well will be restarted and monitoring will continue. This process will continue until the soil vapor concentrations in all the sub-area monitoring wells result in VLEACH groundwater impact results less than 5 $\mu g/l$ as required by the 1990 Consent Decree.

Once a sub-area has passed the VLEACH screening with the post 14-day laboratory rebound samples, the sub-area will be scheduled for confirmatory closure sampling 90 days after the 14-day VLEACH results are complete and reported to U.S. EPA. A sub-area passing the post 14-day VLEACH screening formally places the sub-area into rebound for closure. A total of 35 days is included in the schedule for reporting results to U.S. EPA and to allow for laboratory sample analysis and VLEACH screening. Figure 6-6 illustrates the chronological flow for sub-area operation, monitoring, rebound and closure. The second closure vapor sampling will occur approximately 139 days following sub-area shut down. This sampling schedule is based on the vapor rebound results of the 1988 SVE pilot test. Since soil vapor re-equilibration is a log-normal function, the highest amount of recovery will occur in the first log cycle (or first 10 days) with declining recovery following. The confirmatory sample, collected approximately 139 days following sub-area shut down should encompass over 90% of the total vapor recovery or rebound. This assumption is also valid since the criterion for the initial laboratory sampling is the lower-ARM concentration which has a safety factor of 4 built-in for vapor rebound (e.g. 1.25 $\mu g/L$ is the lower-ARM value as opposed to the threshold ARM of 5.0 $\mu g/L$. See Section 7.0.). A total of 35 days is included in the schedule for the post 14-day sample VLEACH screening and the closure VLEACH screening. See Figure 6-6.

Once sub-area wells have been confirmed for closure, Goodyear will schedule them for decommissioning. However, Goodyear will reserve the option of operating a closed sub-area extraction well for the purpose of system air blending balance, stagnation zone adjustment, or other purposes until all the polygon sub-areas have been confirmed by U.S. EPA for closure.

6.7 Soil Vapor Contaminant Composition and Maximum Concentration

Collected SVE extraction and monitoring well soil vapor samples will be analyzed for maximum solvent concentration to determine the type and concentration of contaminant(s) present in the vapor. For maximum concentration field analyses, total ionizable volatile compounds will be measured using a portable PID instrument, and/or the field GC. The field GC will be used for speciation of the four targeted compounds TCE, PCE, 1,1-DCE, and 1,1,1-TCA. For baseline analysis, the analyst will quantify and sum the individual concentrations of the four VOC target compounds which include TCE, PCE, 1,1-DCE, and 1,1,1-TCA, using the GC. The portable PID instrument, when used, will report the concentrations as parts per millon vapor (ppmV) as TCE. The instrument will be calibrated as indicated in the O&M QAPP, Appendix D. Fixed gas analyses (CO_2, O_2, CH_4) will be screened in the field using a portable infra-red gas analyzer and used to evaluate well sealing efficiencies (Section 6.9) and to evaluate SVE influence within the "upper-fine" and "lower-coarse" vadose zone.

6.8 Critical Soil Vapor Flow/Vacuum Rate Determination

The goal of operating the SVE extraction well(s) is to maximize VOC extraction through controlling the parameters, where possible, that affect VOC transport and removal. During start-up operations, the SVE system will be operated at a range of system flow and differential vacuum conditions. Following field analysis of soil vapor samples, and completion of air permeability, radial velocity, and flow field analyses, Goodyear will evaluate and calculate the optimal system parameter values that yield the maximum contaminant concentrations from the vadose zone soils existing in the sub-areas of the treatment polygon. It is expected that subsurface conditions may change over time, therefore, Goodyear will collect pertinent data to determine the most efficient on-going remedial operating parameters. For example, various flow rates will be tested during start-up along with their corresponding concentrations. Once the parameters have been developed, the polygon wells will be operated to maximize operational efficiency.

6.9 Extraction Well Efficiency

Determination of the efficiency of the individual wells may be evaluated through the collection and evaluation of field vadose zone fixed gas concentrations. The fixed gas concentrations in the PGA vadose zone, particularly oxygen, are generally less than 17% by volume. If the oxygen concentrations in the SVE extracted vapor or the nearest soil vapor monitoring well are significantly higher than 17%, vapor short circuiting is likely occurring from the ground surface. Carbon dioxide is also present in small amounts (1 to 5%) likely as a result of aerobic respiration in the degradation of groundwater and/or vadose zone contaminants. The fixed gas concentrations of the sub-area extraction and monitoring wells will be analyzed through the use of a portable infrared vapor analyzer. Samples from the extraction and monitoring wells will be collected using a negative pressure box in 3-liter Tedlar bags as outlined earlier and detailed in the 1992 Design Memorandum and Appendix D. The Tedlar bag samples will be screened first for total VOCs with the portable PID then analyzed for carbon dioxide and oxygen using the infrared analyzer. All field sample collection and screening data will be recorded in the field log and the data will be included in Goodyear's monthly report to U.S. EPA.

All wells will be operated in a manner to minimize the effects of ambient air short-circuiting and maximize well efficiency. Extraction wells exhibiting oxygen concentrations in excess of the sub-area background oxygen concentrations will be adjusted to minimize extraction well short- circuiting. The adjustment will involve the reduction of the extraction well flow rate and vacuum to a level that minimizes the effects of short-circuiting while maintaining the required radius of sub-area treatment influence. Once the extraction well flow and vacuum has been adjusted, the sub-area monitoring well will be monitored to confirm a continuous vacuum distribution throughout the sub-area.

6.10 Sub-Area Remediation Duration Modeling

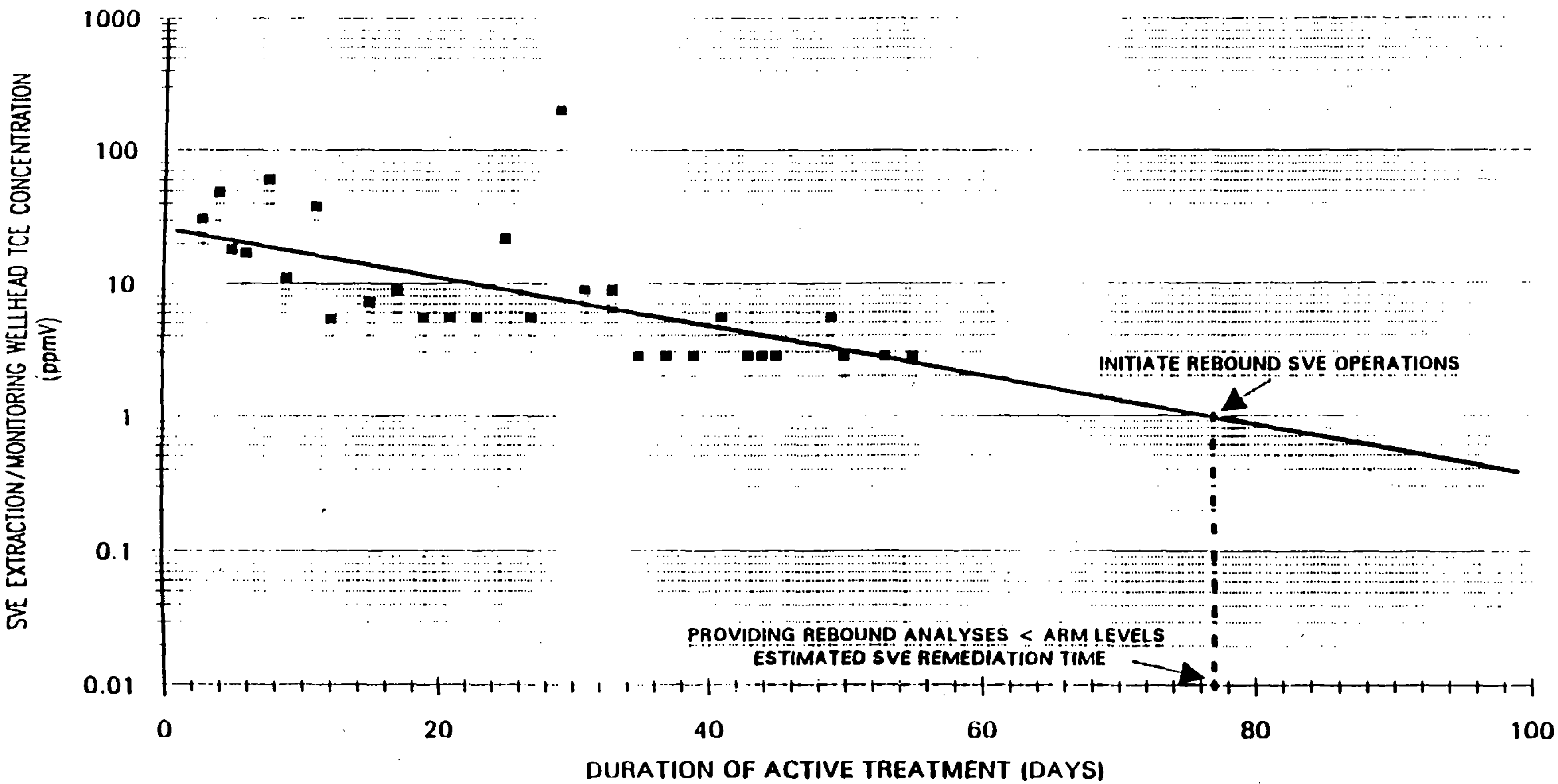
In an effort to predict the SVE extraction well start-up and shut-down cycles, M&E will develop simple sub-area-specific predictive models for VOC concentration decay.

Field and laboratory VOC data collected during both operation and shut-down will be plotted to evaluate any trend in the data. Based on the data trend, a regression equation will be fitted to the data for production purposes. Once the regression model has been determined for each sub-area, the lower-ARM concentration (Section 7) for the sub-area will be input and the total operational duration to achieve this concentration will be predicted. Figure 6-7 illustrates a typical sub-area predictive model utilizing an exponential regression equation. Since the vapor decay and rebound concentrations during the pilot test displayed a log-normal behavior, it is anticipated that the sub-area predictive models will also follow a log-normal pattern.

As additional data become available, they will be added to the model and the predictive model equation will be updated to reflect the real-time data. Once the model has been updated, a new predicted remediation time to achieve the lower-ARM concentration will be generated. These simple predictive models will only be used in evaluating sub-area treatment durations and estimating the initiation times of rebound periods. Use of the models will assist in highlighting sub-areas that require longer SVE treatment so that they can be prioritized during all phases of operation. The models can also be used to balance the overall polygon treatment flow based on the sub-area prioritization. Sub-area prioritization and flow balancing, through the use of the models, will ultimately result in shorter overall polygon remediation time frames by focusing treatment on those sub-areas requiring it most, which will result in the sub-areas being completed at approximately the same time.

FIGURE 6-7

ESTIMATED SVE REMEDIATION DURATION FOR A HYPOTHETICAL SVE EXTRACTION WELL



NOTE: ARM CONCENTRATION > 1 ppmV

7.0 SVE EXTRACTION WELL REBOUND MONITORING

During on-going SVE extraction well operation, subsurface soil vapor concentrations will decrease as remediation progresses. At these instances when the vapor concentrations reach the lower-ARM level, it is scientifically and economically prudent to temporarily discontinue SVE operation and permit SVE operational subsurface conditions to re-equilibrate to ambient vadose zone conditions. Intermittent SVE operation is herein termed "pulsing" and is in accordance with the conditions of Appendix B of the 1990 Consent Decree. During the periods when a sub-area is shut down, monitoring is essential to assess the potential of VOC soil vapors to recollect and "rebound." As SVE remediation progresses within the sub-area extraction wells, the targeted SVE soils may reach a situation where further removal of volatile vapors becomes a "diffusion-limited" process (i.e., regardless of the vacuum applied to an extraction well, in the short term, the net removal of volatile vapors remains essentially the same). This diffusion limited condition has a potential to exist within the upper-fine vadose zone to a greater extent than in the lower-coarse vadose zone, given the diminished ability of the fine soils to readily transmit advectively driven vapor flow. Since the bulk of the polygon VOC mass is in the lower-coarse vadose zone, the productive SVE extraction well will remain on line until the lower-ARM levels are obtained.

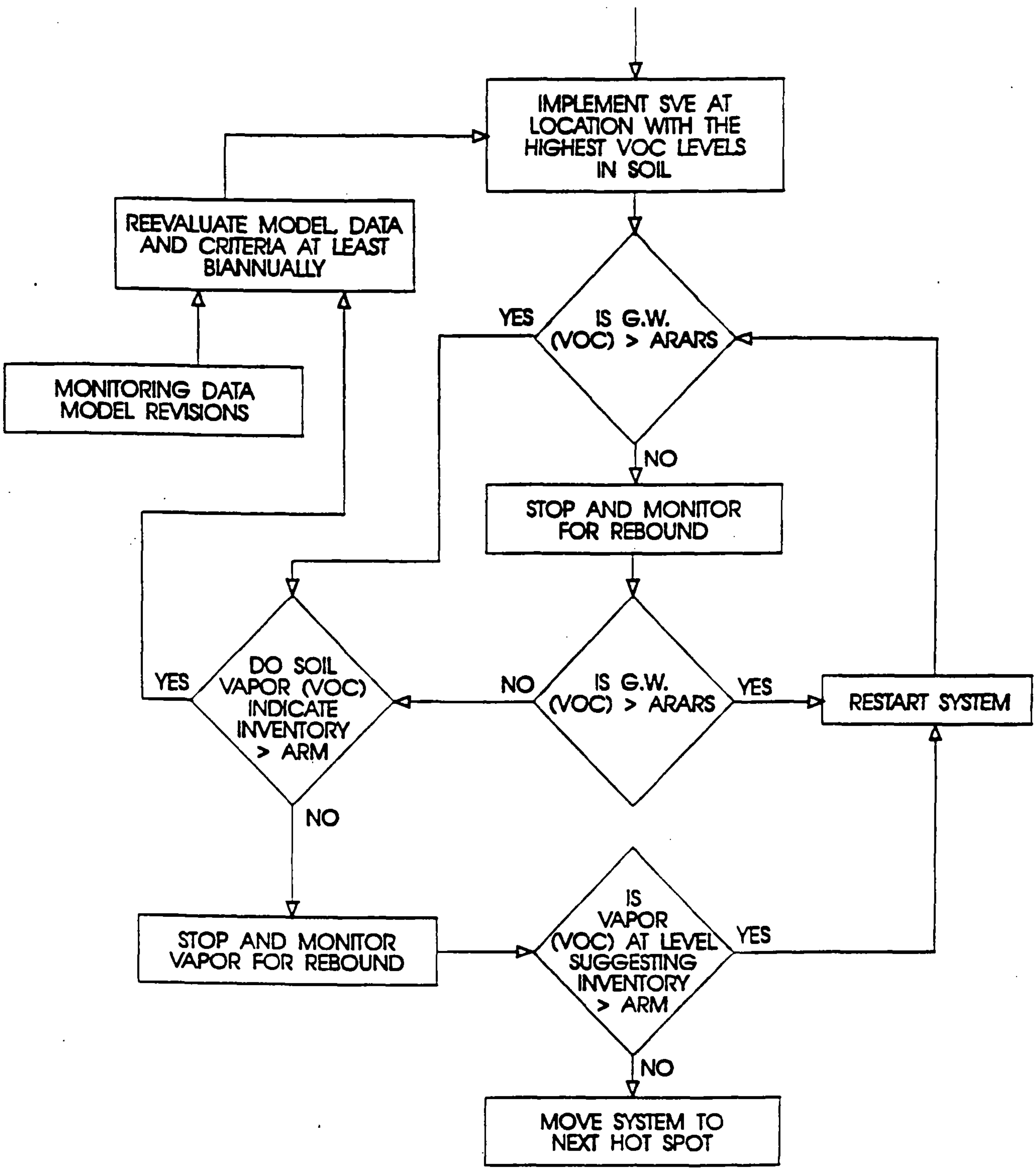
Routine monitoring of SVE monitoring wells will continue as long as VOC concentrations measured from the operating SVE extraction well remain above the soil vapor concentration determined by VLEACH to exceed the sub-area specific lower-ARM concentration. In the event where the SVE extraction wells screened across both the upper-fine and lower-coarse soils fail to yield VOC concentrations of at least the lower-ARM concentration as measured by the field instrumentation (PID), the SVE system and extraction well valves will be shut off. The incidence of subsequent rebound monitoring will be initiated after it is determined through field monitoring that the first sub-area SVE extraction well vapors meet or fall below the lower-ARM concentration. Figure 6-6 graphically presents the decisional flow chart for SVE monitoring, rebound and closure.

During the period that the SVE system is off, the dynamic relationship between the sorbed, dissolved, and gaseous phases are permitted to re-equilibrate, and volatile gases are permitted to naturally diffuse into and fill previously evacuated pores within the soil matrix. Subsequent SVE operation, if required, will readily remove the collected vapors and the process is repeated until the targeted cleanup level is achieved and sustained as determined by VLEACH and MixCell in accordance with Appendix B of the 1990 Consent Decree. Should rebound exceed the ARM after two laboratory sampling events as a result of volatilizing groundwater, SVE system operations will be suspended for U.S. EPA negotiations.

The proposed O&M schedule, Figure 6-6, provides for a universal, generic schedule once the sub-area lower-ARM concentrations have been met. The schedule flow chart (Figure 6-6) provides the time line for critical operational events. As SVE operations proceed, system performance parameters, as they become available, will provide Goodyear with the necessary data to identify and confirm actual rebound and related monitoring events. Prior to discontinuing SVE operations for rebound assessment, a comprehensive SVE operations monitoring event will be scheduled. Goodyear proposes to allow a time period of 14 days to elapse following SVE shut-down to allow sufficient time for subsurface conditions to equilibrate (see Section 6.6). Immediately following this period, Goodyear will verify that the lower-ARM concentrations are not exceeded using field instrumentation. If these conditions exist, Goodyear will collect laboratory soil vapor samples from the SVE monitoring wells located within the capture area of the associated sub-area SVE extraction well for analysis.

The analytical soil vapor data collected from the SVE monitoring wells will be treated in a fashion similar to that discussed in Section 2.1 of the November 25, 1992 SVE Final Design. Following input into the VLEACH and MixCell models, a determination will be made as to whether ARM concentration levels have been met within the sub-area (Figure 7-1) and what the concentrations are. This determination will hinge upon the potential of the existing soil vapor concentrations within the sub-area to result in Subunit A groundwater concentrations above 5.0 μg/L as determined by VLEACH and MixCell screening. A total of 35 days is included in the schedule for receipt of the laboratory analysis and screening the sub-area using VLEACH and MixCell. See Figure 6-6.

As shown in Figure 7-2, from Appendix B of the 1990 Consent Decree, an individual SVE sub-area extraction well will continue to operate as long as VLEACH and MixCell modeled groundwater VOC concentrations (as TCE) are greater than ARARs and/or SVE monitoring well soil vapor samples collected during rebound monitoring result in modelled VOC levels that exceed ARM criteria. If either the groundwater VOC ARARs or soil vapor ARM levels fall below acceptance criteria, the



APPENDIX B 9/1990 CONSENT DECREE PROPOSED DECISION TREE FOR OPERATION OF THE SOIL VACUUM EXTRACTION SYSTEM

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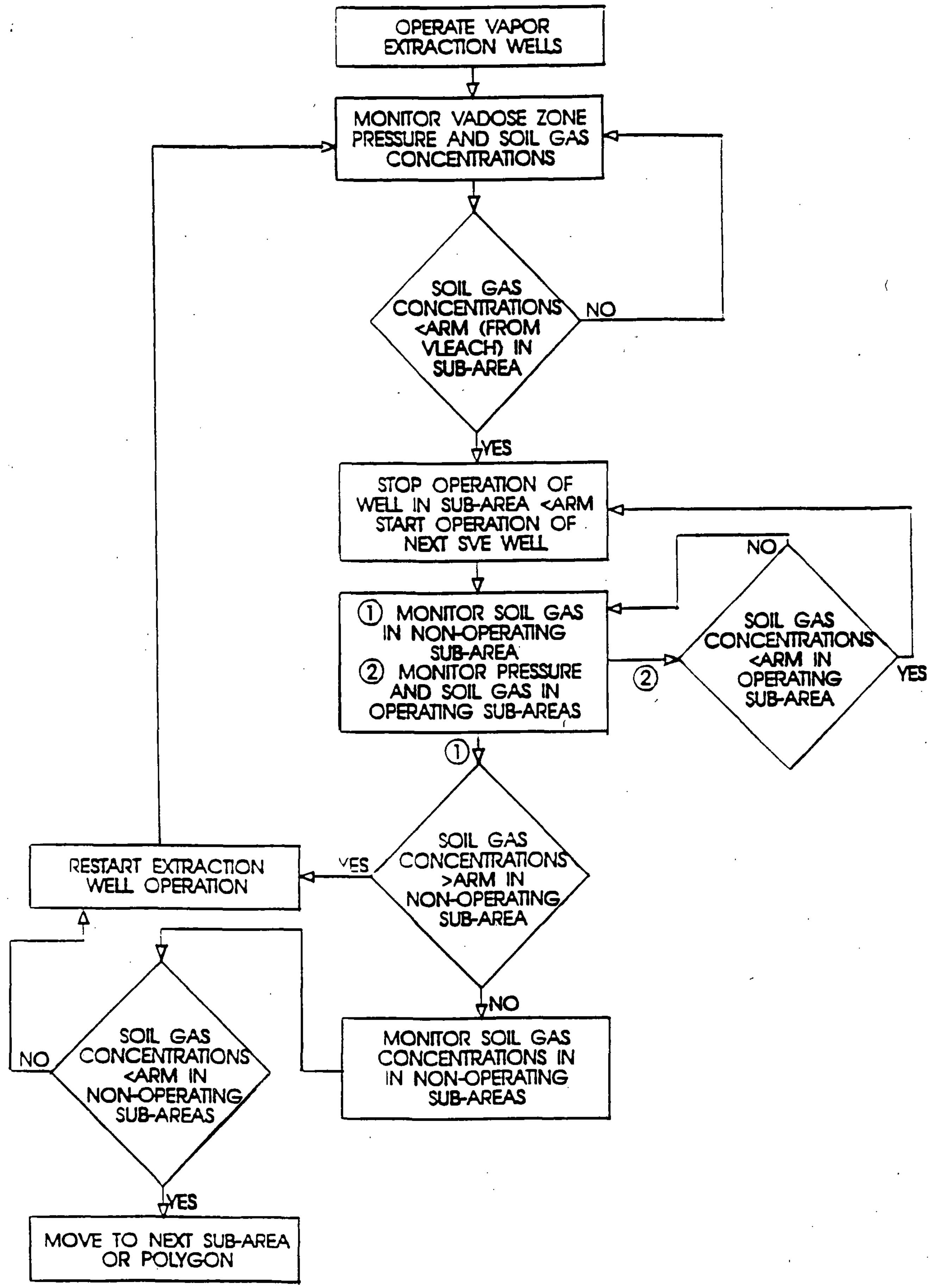
Drawn by: J. Weldmann	Job Number: 006791	Date: 20 March 1992
Checked by: S. Zachary		Figure Number: 7-1



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SVE WELL OPERATION CHART

FIGURE 7-2

SVE system will be shut down and be monitored for rebound. If, following rebound monitoring, soil vapor concentrations are greater than ARM levels, SVE operation will be re-initiated or continue. Alternately, in the event that rebound monitoring groundwater VOC concentrations are less than ARARs and soil vapor samples result in modelled VOC concentrations below ARM levels, the operating SVE extraction well will be shut off. This process will continue until all of the sub-areas within the polygon comply with Appendix B of the Consent Decree (see Figure 7-2). In order for a sub-area to be permanently discontinued from further SVE remedy, soil vapor concentrations must remain below the ARM (< 5 μg/L in groundwater by VLEACH) for a period of 90 consecutive days following the initial post 14-day rebound monitoring and VLEACH screening. See Figure 6-6. If this condition is upheld for any particular sub-area(s), SVE remediation will be permanently discontinued for that sub-area(s).

7.1 ARM Estimation Criteria for Rebound Monitoring

The sub-area specific ARM concentration threshold(s) with which to base a decision as to whether or not to shut off an extraction well and initiate rebound monitoring within a sub-area are ultimately based on VLEACH and MixCell model results. These models are based on the assumption that vadose zone contamination is the source of Subunit A groundwater contamination. Integration of field derived SVE monitoring data into a decision matrix that will lead to laboratory analyses and computer modeling requires a useful and flexible protocol. Additionally, because there exists a large number of vertical distribution(s) and soil vapor concentration(s) combinations that may result in a sub-area passing VLEACH and MixCell screening (Subunit A groundwater TCE concentrations less than 5 μg/L), the protocol must be able to reduce the concentration/distribution matrix to a manageable size. In order to address these manifold requirements, an approach has been developed which is based on estimating projected likely soil vapor monitoring well concentration and vertical distribution scenarios following SVE operation at individual sub-areas within the polygon undergoing treatment. The rationale used to estimate projected soil vapor concentrations and resultant vertical distributions of VOCs in the vadose zone following SVE remedy incorporates existing soil vapor data collected from Phase II vapor monitoring wells, known physical soil parameters, soil vapor concentrations, VOC vertical distributions, and experience at operating the SVE system at Polygons 79 and 84. The approach includes flexibility to take into account current vadose zone conditions to adjust the modeling and monitoring program. A description of this approach as it pertains to the polygon being treated and how Goodyear proposes to utilize this approach for closure of each sub-area is described below in a step-wise manner.

Initially, the existing total soil vapor concentrations and resultant vertical distribution of VOCs in the vadose zone were utilized from results of the June, 1993 Phase I/II investigation at Polygons 96/92 and 27A. Evaluation of these investigative results are summarized in Table 7-1.

Table 7-1
Phase II Vadose Zone Well Contaminant Distribution

Polygon Wells	Total VOC Vapor Concentrations as TCE (ppmV)	Total Soil Concentration (ug/kg) *	VOC Location / Loading
VP-96-13	31	96	middle upper-fine / lower coarse
VP-96-26.5	210	659	
VP-96-37.5	220	719	
VP-96-50	150	473	
VP-92-17	35	85	bottom / lower coarse
VP-92-28	167	415	
VP-92-40	211	531	
VP-92-52	440	1201	
VP-27A-12	170	533	bottom / lower coarse
VP-27A-21	290	898	
VP-27A-36	420	1318	
VP-27A-45	440	1378	

NOTES:

* Total soil concentrations generated by converting vapor concentrations from ppmV to ug/L, then multiplying by site K_s + value of 0.599 L/Kg.

** Upper-fine vadose zone = 0 to 30 feet below grade.
Lower coarse vadose zone = 30 to 60 feet below grade.

Silty and clayey materials have been noted to occur from ground surface to approximately 30-feet below grade defining an "upper fine" vadose zone. The "upper fine" zone sharply grades into coarser sandy and gravelly materials from 30 to 60 feet below grade which has been termed the "lower coarse" zone. Based on these conditions, the vadose zone above the Subunit A aquifer can be separated into two general units about the site. Based on this local geologic condition, SVE remedy within the Subunit A vadose zone is anticipated to strongly favor VOC removal within the lower coarse materials due to both higher permeabilities characterizing the "lower coarse" materials, as well as overall greater VOC concentrations. These conditions were observed to be the case in both the 1988 SVE pilot test and during the SVE remedy at Polygons 79 and 84. These conditions form the basis for simulating various vadose zone remediation levels to achieve sub-area closure. In order to evaluate the necessary sub-area vadose zone remediation level as determined by soil vapor, the VLEACH and mixing cell model was utilized incorporating the 1993 Polygon-specific VOC concentrations and vertical distributions illustrated in Table 7-1 with the data trends observed during SVE remedy at Polygons 79 and 84.

Analysis of the 1988 SVE pilot test recovery data in Polygon 79 revealed that after only ten days of treatment, the vadose zone concentrations were reduced by 73% (3,700 μg/L to 1,004 μg/L). After twelve days of rebound, approximately 15% of the initial concentration rebounded (436 μg/L) with a total rebound of 21% (794 μg/L) of the pre-test concentrations. Based on this analysis, a total rebound factor of 1.79 (1,798 μg/L ÷ 1,004 μg/L) was established for Polygon 79. Similar results were observed at Polygon 84. Incorporating unknown variables such as dynamic soil moisture content, VOC diffusion from adjacent polygons, and VOC volatization from the water table, a conservative rebound factor of 4.0 is used as the target to initiate rebound monitoring for sub-area closure. This rebound factor was found to accurately represent the dynamic vapor-phase equilibrium in the vadose zone during remedy operations in both Polygons 79 and 84. Based on these data, the same rebound factor will be used for Polygons 96, 92 and 27A.

In order to establish sub-area operation/shut down initiation milestones, the VLEACH and MixCell model was utilized. The June 1993 soil vapor concentrations and their vertical distributions illustrated in Table 7-1 were input into the models. Model simulations are performed which systematically reduced the VOC concentrations in the vadose zone to achieve the EPA defined polygon-specific ARM. In addition to evaluating the ARM concentrations (soil vapor concentrations resulting in groundwater TCE concentrations of 5 μg/L using the VLEACH and MixCell models), a lower-ARM concentration was evaluated. The lower-ARM concentration is determined by using the rebound safety factor of 4.0 applied to the threshold ARM. Based on the site-specific remediation level of 5 μg/L as TCE in Subunit A groundwater, the lower-ARM VLEACH and MixCell concentration is set at approximately 1.25 μg/L (5.0 μg/L ÷ 4) as TCE in Subunit A groundwater. As sub-area operational data becomes available, the lower-ARM factor will be modified accordingly to minimize the number of rebound periods necessary for sub-area closure.

To evaluate the threshold ARM and lower-ARM reduction concentrations necessary for sub-area closure, the VLEACH model was used for simulations in the following manner:

- Input the converted total soil concentration distribution values (μg/Kg) in Table 7-1 using parameters in Table 7-2 with the appropriate sub-area specific values into the VLEACH model. The total soil concentration value will be entered adjacent to the ten 6-foot thick cells comprising the vadose zone.

- Run the VLEACH model at 1-year mass flux output statements, 10-year printout summaries, over a 30-year duration (or until a peak mass flux is demonstrated).

- Run the mixing cell model using the VLEACH output with groundwater impact printouts on a 1-year basis over the duration that the VLEACH model was run (e.g., typically a 30-year duration).

- Reiterate this process using a range of converted total soil vapor concentration values. Repeat this process until an approximate threshold total soil vapor concentration and associated threshold ARM value is established that, when exceeded, gives rise to contributing to Subunit A groundwater TCE concentrations in excess of 5 μg/L.

- Convert this threshold total soil vapor concentration (μg/L) into units of parts per million by volume (ppmV) as TCE.

- Use this adjusted sub-area specific total soil vapor concentration in ppmV as TCE as the field monitoring criteria for ARM estimation.

Using this approach allows for a technical basis for sub-area operation and shut-down that is tied to the VLEACH model and the 1992 Consent Decree (Appendix B). Since each sub-area may contain vadose zone-specific parameters that effect contaminant transport and removal, each sub-area may have an ARM threshold concentration developed from sub-area specific soil vapor data. Development of these parameters for each sub-area will allow for SVE operation to be suspended in one or more areas during polygon remediation.

Table 7-2
SUMMARY OF SOIL PHYSICAL AND CHEMICAL PARAMETERS USED IN DETERMINING TOTAL SOIL TCE CONCENTRATIONS (μg/Kg)

Parameter	Value	Units
K_D	0.0915	L/Kg
f_{oc}	0.074%	Dimensionless
K_h	0.473	Dimensionless
C_g	Varies	μg/L
C_T	Varies	μg/Kg
ρ_b	1.64	g/cm^3
Θ_T	38.1%	Dimensionless
Θ_w	25.5%	Dimensionless
K_{oc}	123.6%	L/Kg
KgT	0.599	L/Kg
Depth to Ground Water	60	ft

Note:
* From Lyman (1982)

Three model scenarios were executed for each of the three polygons. These runs include the current polygon status, and two additional runs with reductions in the VOC concentrations. Modeling run numbers 1, 2, and 3 presented in Table 7-3 each focus on realistic scenarios where reduced vapor concentrations have been calculated using synthetic data within the lower coarse zone.

Model 1 demonstrates the current polygon modeling conditions with a resultant Subunit A groundwater concentration of 5.685 μg/L. Referring to Table 7-2, Model Run 2 estimates resultant Subunit A groundwater impact based on reducing the existing total soil concentration at the two deep piezometers at Polygon 84 by 15%. Specifically, this constitutes a reduction in piezometer VS-VP84-36 from a concentration of 380.37 μg/Kg to 323.31 μg/Kg, and in piezometer VS-VP84-45 from 748.15 μg/Kg to 635.93 μg/Kg. Loading these synthetic data-reduced concentrations into the VLEACH and MixCell screening models yields an estimated Subunit A groundwater impact of 4.833 μg/L. The results of Model Run 2 pass the VLEACH and MixCell screening by reducing Subunit

Table 7-3
ARM ESTIMATION CALCULATIONS FOR POLYGON 96 SUB-AREAS MONITORING

ARM Modeling Run Number	Soil Vapor Monitoring Piezometer Designation*	Modelled Total Soil Concentration (µg/Kg) Reduction in each Piezometer**	Percentage Reduction from Actual Concentration	Approximate Corresponding Soil Vapor Concentration (Converted from µg/L to ppmV as TCE)	Modelled Maximum Subunit A Impact to Groundwater (µg/L)
1	VP-96-13 VP-96-26.5 VP-96-37.5 VP-96-50	96 659 719 473	0 0 0 0	29 201 219 144	26.992
2	VP-96-13 VP-96-26.5 VP-96-37.5 VP-96-50	96 198 72 47	0 70 90 90	29 60 22 15	4.846
3	VP-96-13 VP-96-26.5 VP-96-37.5 VP-96-50	48 33 22 14	50 95 97 97	15 10 7 4	1.239

NOTES:
* See Appendix C for the well construction logs. VP-96 installed during 1993 Phase II Investigation.
** Based on Projecting Residual VOCs assuming On-going SVE Remedy.
BOLD print indicates that the Modelled Concentrations and Distributions passed the VLEACH and MixCell testing.

A groundwater TCE concentrations below the MCL of 5 µg/L. In order to remain conservative, to anticipate soil vapor rebound conditions, and to minimize rebound cycles following SVE sub-area well shutdown, the targeted MixCell Subunit A groundwater result was set at one quarter of the MCL, or at approximately 1.25 µg/L.

In order to evaluate what initial soil vapor concentrations would give rise to a MixCell determined Subunit A groundwater concentration of approximately 1.25 µg/L, additional model runs were completed in an iterative fashion. Model Run 3 simulates reduced soil vapor concentrations within the vadose zone to yield a maximum Subunit A groundwater concentration of approximately 1.25 µg/L, as determined by the VLEACH and MixCell screening models. Tables 7-3, 7-4 and 7-5 present the various present state (Run 1), ARM (Run 2), and lower-ARM (Run 3) model simulations for Polygons 96, 92 and 27A, respectively. See Appendix H for the modeling support data.

Table 7-4
ARM ESTIMATION CALCULATIONS FOR POLYGON 92 SUB-AREAS MONITORING

ARM Modeling Run Number	Soil Vapor Monitoring Piezometer Designation*	Modelled Total Soil Concentration (μg/Kg) Reduction in each Piezometer**	Percentage Reduction from Actual Concentration	Approximate Corresponding Soil Vapor Concentration (Converted from μg/L to ppmV as TCE)	Modelled Maximum Subunit A Impact to Groundwater (μg/L)
1	VP-92-17	85	0	26	7.559
	VP-92-28	415	0	127	
	VP-92-40	531	0	162	
	VP-92-52	1201	0	367	
2	VP-92-17	85	0	26	4.917
	VP-92-28	415	0	127	
	VP-92-40	345	35	106	
	VP-92-52	780	35	239	
3	VP-92-17	85	0	26	1.219
	VP-92-28	415	0	127	
	VP-92-40	85	84	26	
	VP-92-52	192	84	59	

NOTES:
* See Appendix C for the well construction logs. VP-92 installed during 1993 Phase II Investigation.
** Based on Projecting Residual VOCs assuming On-going SVE Remedy.
BOLD print indicates that the Modelled Concentrations and Distributions passed the VLEACH and MixCell testing.

Table 7-5
ARM ESTIMATION CALCULATIONS FOR POLYGON 27A SUB-AREAS MONITORING

ARM Modeling Run Number	Soil Vapor Monitoring Piezometer Designation*	Modelled Total Soil Concentration (μg/Kg) Reduction in each Piezometer**	Percentage Reduction from Actual Concentration	Approximate Corresponding Soil Vapor Concentration (Converted from μg/L to ppmV as TCE)	Modelled Maximum Subunit A Impact to Groundwater (μg/L)
1	VP-27A-12	533	0	162	5.943
	VP-27A-21	898	0	275	
	VP-27A-36	1318	0	403	
	VP-27A-45	1378	0	421	
2	VP-27A-12	533	0	162	5.053
	VP-27A-21	898	0	275	
	VP-27A-36	1120	15	342	
	VP-27A-45	1171	15	358	
3	VP-27A-12	400	25	122	1.186
	VP-27A-21	674	25	206	
	VP-27A-36	198	85	60	
	VP-27A-45	207	85	63	

NOTES:
* See Appendix C for the well construction logs. VP-27A installed during 1993 Phase II Investigation.
** Based on Projecting Residual VOCs assuming On-going SVE Remedy.
BOLD print indicates that the Modelled Concentrations and Distributions passed the VLEACH and MixCell testing.

Included in Tables 7-3 through 7-5 for each synthetic model condition is the equivalent soil vapor concentration in units of ppmV as TCE corresponding to the modelled total soil concentration (μg/Kg) for each soil vapor piezometer. The conversion first utilized Equation 7-1 giving units of μg/L, which were then converted to units of ppmV according to the following equation:

$$C_g\ (\mu g/L) \times 24.04/MW = C_g\ (ppmV)$$

Equation 7-1

where:

MW = molecular weight of TCE (131.39 grams)

Tables 7-3, 7-4 and 7-5 contain the converted soil vapor concentration data (ppmV) for each of the three polygons for the base concentrations as well as the ARM and lower-ARM concentrations. For

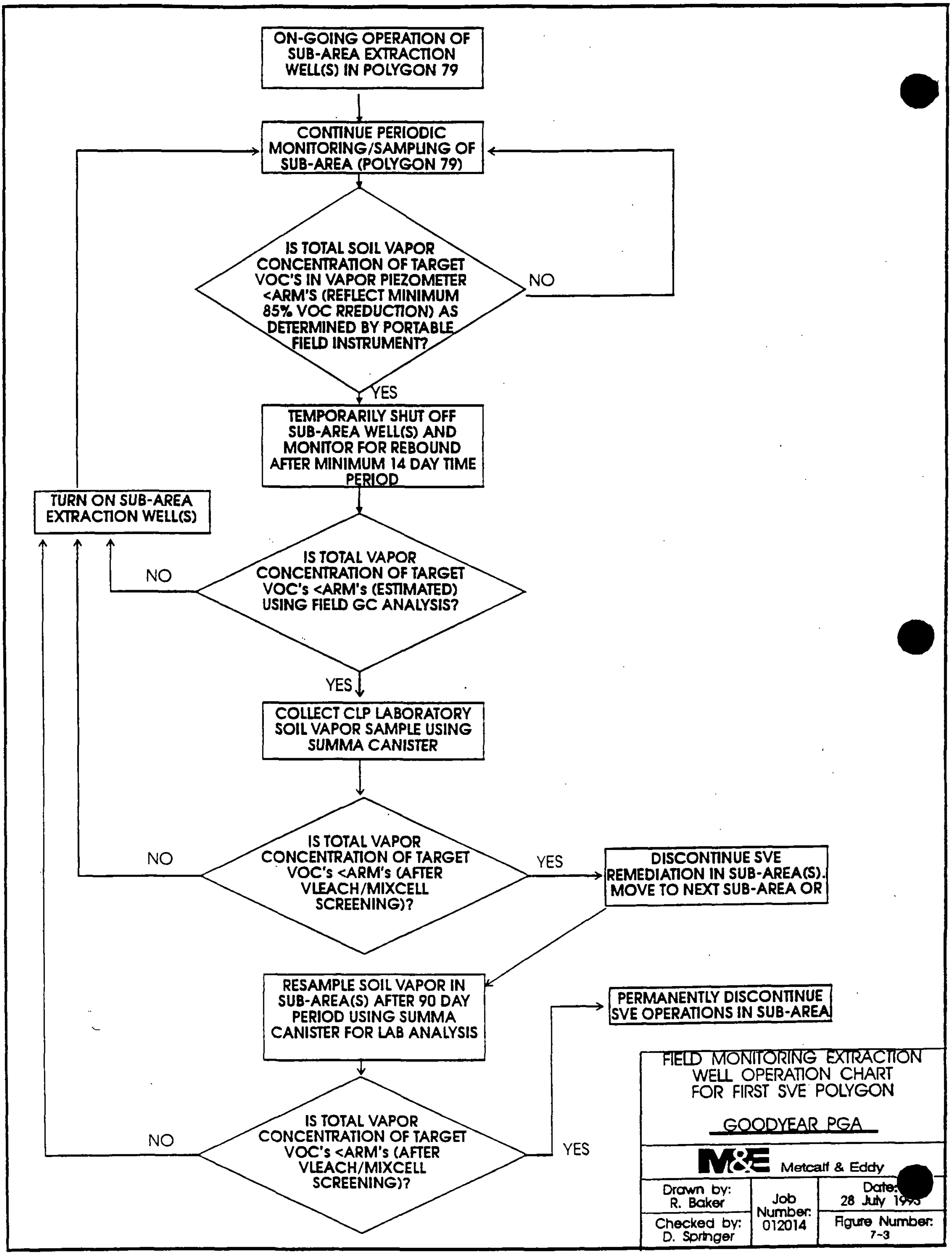
Tables 7-3, 7-4 and 7-5 contain the converted soil vapor concentration data (ppmV) for each of the three polygons for the base concentrations as well as the ARM and lower-ARM concentrations. For each of the three polygons, the VLEACH and MixCell modeling indicates that the lower-ARM soil vapor concentrations will result in modeled groundwater concentrations that meet the conditions of Appendix B of the Consent Decree.

During SVE sub-area operations, the lower-ARM soil vapor concentrations will be used as the basis for sub-area shut-down initiation. It should be noted that all of the soil vapor concentrations in Tables 7-3, 7-4 and 7-5 are in the ppm range, and therefore, field instrumentation can be used for monitoring purposes.

7.2 Field Monitoring for Sub-Area Well Operations

Figure 7-3 provides a flow chart summarizing the proposed field monitoring protocol for SVE sub-area extraction well operation. Referring to Figure 7-3, during ongoing SVE remedy at a sub-area well, routine SVE well monitoring will proceed as described in Section 6.0 of this document. Field soil vapor samples will be collected from monitoring wells using the methods as described in Section 2.1 of the November 25, 1992 SVE Final Design Document and Section 6.0 of this report. Briefly, this method includes an initial purging of the monitoring well, followed by gas collection directly into a 3-liter capacity Tedlar bag using a soil vacuum box.

Purge and sample rates will be maintained at 200 ml/min and new segments of tubing will be used between samples. Upon sample completion, a field photoionization detector (PID) calibrated to the compound TCE will be inserted into the Tedlar bag and the maximum reading recorded. If soil vapor concentrations as determined by the field instrumentation are measured above sub-area specific lower-ARM concentrations at vapor piezometers, remediation will continue. See Tables 7-3, 7-4 and 7-5 for the lower-ARM soil vapor concentrations. If however, soil vapor monitoring levels at individual piezometers are determined to be at or below sub-area specific lower-ARM concentrations, shut-down for that sub-area will be initiated. Initiation of sub-area shut-down monitoring will consist of three major phases: initial rebound, model sampling, and closure sampling. Each of these phases are described below.



FIELD MONITORING EXTRACTION WELL OPERATION CHART FOR FIRST SVE POLYGON

GOODYEAR PGA

M&E Metcalf & Eddy

Drawn by: R. Baker	Job Number: 012014	Date: 28 July 199
Checked by: D. Springer		Figure Number: 7-3

Initiation of sub-area shut-down will commence with the initial rebound phase. The initial rebound phase allows the treated sub-area vadose zone to re-equilibrate with respect to the contaminant liquid, soluble and vapor phases. Based on the Polygons 79 and 74 operations data, a period of 14 days has been estimated to be a representative rebound period since greater than 75% of the possible rebound had occurred during this period in the past (see Section 6.6). As with other sub-area treatment parameters, this period will be adjusted as operational data becomes available to minimize the number of necessary rebound events. If the soil vapor concentrations rebound is greater than 20% of the initial or previous sub-area maximum concentration, whichever is latest, the sub-area extraction well will be restarted. If the soil vapor concentrations rebound less than 20% of the initial or previous sub-area maximum concentration, samples will be collected from the sub-area monitoring well for Contract Laboratory Program (CLP) laboratory analysis. The sub-area monitoring well will be sampled using the identical protocol specified in Section 2.1.3.6 of the November 25, 1992 SVE Final Design Document, and in the Phase I/II Quality Assurance Project Plan, and submitted to a CLP Approved laboratory for certified analysis using the TO-14 analytical methodology.

Analytical results of laboratory submitted samples will be input into the VLEACH and MixCell models using the criteria established in Section 2 of the November 25, 1992 SVE Final Design Document. Specifically, for laboratory results of soil vapor rebound samples, the only change that will be imposed to the model input process is the analytical data and its resultant verified distribution. All other process and model input variables will remain unchanged. In this context, SVE remediation progress will be gauged based on soil vapor concentration data only.

Individual sub-area extraction wells within a given polygon are numbered sequentially beginning with the polygon number followed by the number 1 and counting upwards to include all the wells within the polygon. Since the point of compliance with each sub-area is its associated monitoring well, all samples for VLEACH screening will be collected from the monitoring wells.

A total of three sub-areas exist in Polygons 96 and 92, and one sub-area in Polygon 27A. Extraction wells contain a prefix, VEW, in designation while monitoring wells contain a VP prefix. See Drawing 96-C-1, Appendix A.

VLEACH and MixCell simulations and data reports will contain the header which pertains to its sub-area. For instance, the second sub-area in Polygon 96, named 96-2, will contain extraction well VEW-96-2 and monitoring well VP-96-2. Vapor samples for compliance will be collected from VP-96-2 and the laboratory data, once received, will be input into the VLEACH and MixCell models under the header 96-2. All data reporting will contain the appropriate designation prefixes for continuity.

If the modelling results demonstrate that the sub-area well fails the VLEACH and MixCell screening, the sub-area extraction well will be turned on and SVE monitoring will continue. If, however, modelling results demonstrate that the sub-area well falls below the sub-area ARM threshold levels, then the sub-area rebound period will officially commence and a final round of sampling and analysis for closure will follow 90 days later. Reference Sharp letter to U.S. EPA dated October 29, 1993 regarding rebound verification. Following this 90-day rebound period, a second round of analytical soil vapor samples will be collected from the sub-area SVE monitoring well and submitted to the CLP approved laboratory for analysis. See Figure 6-6. These data will be input into the VLEACH and MixCell screening models to evaluate whether the sub-area well continues to pass the screening test. If the resultant Subunit A groundwater TCE concentrations as determined by the VLEACH and MixCell models fall above the Consent Decree limit of 5 μg/L, then SVE operations will be re-initiated at the sub-area extraction well. If, however, Subunit A groundwater concentrations continue to fall below the Consent Decree limit of 5.0 μg/L, the sub-area well operation will be permanently discontinued, and SVE operations will proceed in the next prioritized sub-area.

Use of this approach allows for a technical basis for sub-area operation and shut-down that is tied to the 1990 Consent Decree. Since each sub-area may contain vadose-zone specific parameters that effect VOC contaminant transport and removal, each individual sub-area may have a lower-ARM and threshold ARM concentration developed from sub-area specific soil vapor data. Development of these parameters for each sub-area will allow for SVE operation to be suspended in one or more areas during polygon remediation for rebound monitoring, and/or permanently suspended, based on certified laboratory analysis and VLEACH and MixCell modelling results, if needed. Lastly, the approach for Polygons 96, 92 and 27A have been prepared based on data from SVE operations at Polygons 79 and 84 as well as the 1988 RI/FS SVE pilot test. Since the vadose zone conditions are dynamic with respect to time and location, the decisional criteria presented in this section are estimations. These values will be modified if necessary as current sub-area specific data becomes available. These modifications will be transmitted to U.S. EPA prior to incorporation into the O&M protocol. The results of all monitoring events, laboratory analytical results, and VLEACH and mixing cell modeling will be submitted to U.S. EPA in Goodyear's monthly report.

8.0 REFERENCES

1. Soil Vapor Technical Memorandum, RI/FS, Phoenix-Goodyear Airport RI/FS, 2/27/87, U.S. EPA 30-9L19.0/W63600.FG.

2. Revised Estimate of Volatile Organic Contaminant Mass at the Phoenix-Goodyear Airport Superfund Site, July 19, 1989, prepared by HydroGeoChem, Inc.

3. Freeze, R.A., and J.A. Cherry, 1979. Ground Water. Prentice-Hall, Englewood Cliffs, New York.

4. Estimate of Volatile Organic Contaminant Mass at the Phoenix-Goodyear Airport Superfund Site, May 31, 1989.

5. Consent Decree, 1991, U.S. EPA, Phoenix-Goodyear Airport Superfund Site.

6. Record of Decision, Phoenix-Goodyear Airport Superfund Site, Sept. 1989, U.S. EPA 30-9L19.0/RDD63605.RA.

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8. Maskarenic, M.P., L.H. Johnson, and S.K. Holladay. 1988. Recommendations for Holding Times of Environmental Samples. Proceedings of the U.S. EPA Symposium on Waste Testing and Quality Assurance, Vol. II, July 11-15, The Weston Hotel, Washington, D.C., pp H-29 - H-45.

9. QA/QC Control Guidance for Removal Activities Sampling QA/QC Plan and Data Validation Procedures, U.S. EPA, April 1990. PB(90)-274481.

10. A Compendium of Superfund Field Operations Methods, U.S. EPA, Dec. 1987, PB88-181557.

11. Field Screening Methods Catalog - User's Guide, Sept. 1988, U.S. EPA, 540/2-88/005.

12. Struttmann, T.J. and S.P. Zachary, 1993, Design of Soil Vapor Extraction systems Using Groundwater Flow Models. Proceedings of the Groundwater Modeling Conference, Golden, Colorado, June 9-11, 1993. International Groundwater Modeling Center at the Colorado School of Mines. Section 6, pp. 11-20.

13. Sharp and Associates, Inc., October 29, 1993, letter to U.S. EPA; Phoenix-Goodyear Airport; Soil Vapor Extraction Rebound initiation/verification definition.

14. Metcalf & Eddy, Inc., November 25, 1993, Soil Vapor Extraction (SVE) Final Remedy Consent Decree Final Extraction and Treatment System Design, Phoenix-Goodyear Airport (South) Superfund Site, Goodyear, Arizona.

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16. Metcalf & Eddy, Inc., May 13, 1994, Soil Vapor Extraction (SVE) Final Remedy Consent Decree Final Extraction and Treatment System Design - Polygon 84. Phoenix - Goodyear Airport (South) Superfund Site, Goodyear, Arizona.

17. Metcalf & Eddy, Inc., June 1, 1995, Soil Vapor Extraction (SVE) Final Remedy Consent Decree Final Extraction and Treatment System Design - Polygons 96/92/27A. Phoenix-Goodyear Airport (South) Superfund Site, Goodyear, Arizona.

9.0 GLOSSARY OF TERMS

The following terms and definitions listed below are intended to provide the reader with an understanding of the terminology and technical descriptions presented in the proceeding sections. The terms, where applicable, are consistent with the 1990 Consent Decree terminology.

Primary ARM: Refers to the 1990 Consent Decree stipulated limit in soil concentrations, when if exceeded, give rise to Subunit A groundwater TCE concentrations in excess of 5 μg/L, following VLEACH and MixCell computer model screening.

Lower ARM: Refers to Goodyear's conservative modification of the Primary ARM, which when applied to sub-area SVE monitoring wells, results in Subunit A groundwater TCE concentrations of approximately one-quarter (1/4) of the Primary ARM, or 1.25 μg/L, through VLEACH and MixCell model screening. The lower ARM value is sub-area specific and is to be used as a criterion with which to base the field decision of when to initiate SVE rebound monitoring only, no other purpose is implied.

Lower ARM concentration: The lower ARM concentration is the approximate soil vapor concentration in units of parts per million by volume (ppmV) that is measured at an SVE monitoring wellhead using field instrumentation results in the lower ARM groundwater concentration of 1.25 μg/L as determined by VLEACH and MixCell. The use of the lower ARM concentration value is also sub-area specific, and its utility is limited to basing field decisions on when to initiate rebound monitoring.

SVE: Acronym for Soil Vapor Extraction.

Sub-area: As the term sub-area is used in this document, it represents the total zone of influence in vadose zone soils that a single SVE extraction well imparts during vadose zone SVE remediation. In this context, term is consistent with the 1990 Consent Decree.

Wellhead: The wellhead is the vertical protrusion of well casing above ground surface.

Well Header: The well header is a lateral pipe segment extending from the wellhead that will support SVE monitoring instrumentation and convey extracted vapors to the SVE treatment system.

Pressure: The term pressure as it is used in this document refers to the force per unit area measured above ambient atmospheric conditions. Units of expression may include inches of water, inches of mercury, psi, or bars.

Vacuum: The force per unit area measured below ambient atmospheric conditions. Vacuum uses similar units as pressure and may be used interchangeably throughout this document.

Radius of Influence: The radius of soil vacuum influence (Ri) is defined as the area or volume of vadose zone soil surrounding an SVE well that exhibits a measurable vacuum when the extraction well is exerting a vacuum on the soil. Typically, Ri is expressed as a radial distance away from a designated SVE extraction well in feet or meters.

Sweeping Radius: The sweeping radius (Rs) is defined as the area or volume of vadose zone soil surrounding a SVE well whose soil vapor will be drawn into the producing well over time. The Sweeping radius (Rs) extends beyond the radius of influence (Ri).

Rebound: Refers to the temporary discontinuance of SVE operations on one or more SVE extraction wells for the purpose of permitting ambient subsurface conditions to affect soil vapor concentrations and distributions through multi-phase equilibration. SVE rebound will be utilized at the site to permit SVE monitoring well sampling, assist in tuning SVE system efficiency, advancing through SVE remedial progress over time, and forms the initial phases of sub-area closure.

Upper-fine vadose zone: Refers to the vertical extent of sandy-silt to clayey soils comprising the Subunit A vadose zone about the site extending from ground surface to approximately 30 feet below grade.

Lower-coarse vadose zone: Refers to the vertical extent of coarse sand to gravelly soils comprising the Subunit A vadose zone about the site extending from approximately 30 feet below grade and extending downward to the Subunit A groundwater table.

Phoenix - Goodyear Airport Superfund Site

Soil Vapor Extraction Operable Unit Final Design - Polygon 96/92/27A

Goodyear, Arizona

For:

Goodyear Tire and Rubber Company
Akron, Ohio

SEPTEMBER 1995

LIST OF DRAWINGS

DRAWING NO.	DRAWING TITLE
	COVER SHEET
96-P-1	POLYGON LOCATION MAP
96-C-1	POLYGON SITE MAP I
96-C-2	POLYGON SITE MAP II
96-M-1	TREATMENT SYSTEM LAYOUT, PIPING AND GRADING DETAILS
96-M-2	EXTRACTION WELLS AND PIPING DETAILS I
96-M-3	EXTRACTION WELLS AND PIPING DETAILS II
96-M-4	EXTRACTION WELLS AND PIPING DETAILS III
96-M-5	EXTRACTION WELLS AND PIPING DETAILS IV
96-M-6	EXTRACTION WELLS AND PIPING DETAILS V
96-M-7	EXTRACTION WELLS AND PIPING DETAILS VI
96-M-8	AIR SPARGING DETAILS I
96-M-9	AIR SPARGING DETAILS II
96-M-10	AIR SPARGING DETAILS III
96-M-11	AIR SPARGING DETAILS 1V
96-E-1	ELECTRICAL AND INSTRUMENTATION SYMBOLS
96-E-2	PROCESS & INSTRUMENTATION DIAGRAM 1
96-E-3	PROCESS & INSTRUMENTATION DIAGRAM 2
96-E-4	PROCESS & INSTRUMENTATION DRAWING 3
96-E-5	ELECTRICAL ONE LINE AND INTERCONNECTION DIAGRAM
96-E-6	ELECTRICAL CONTROL WIRING DIAGRAM
96-E-7	ELECTRICAL CONTROL PANELS
96-E-8	ELECTRICAL UTILITY SERVICE CONNECTIONS

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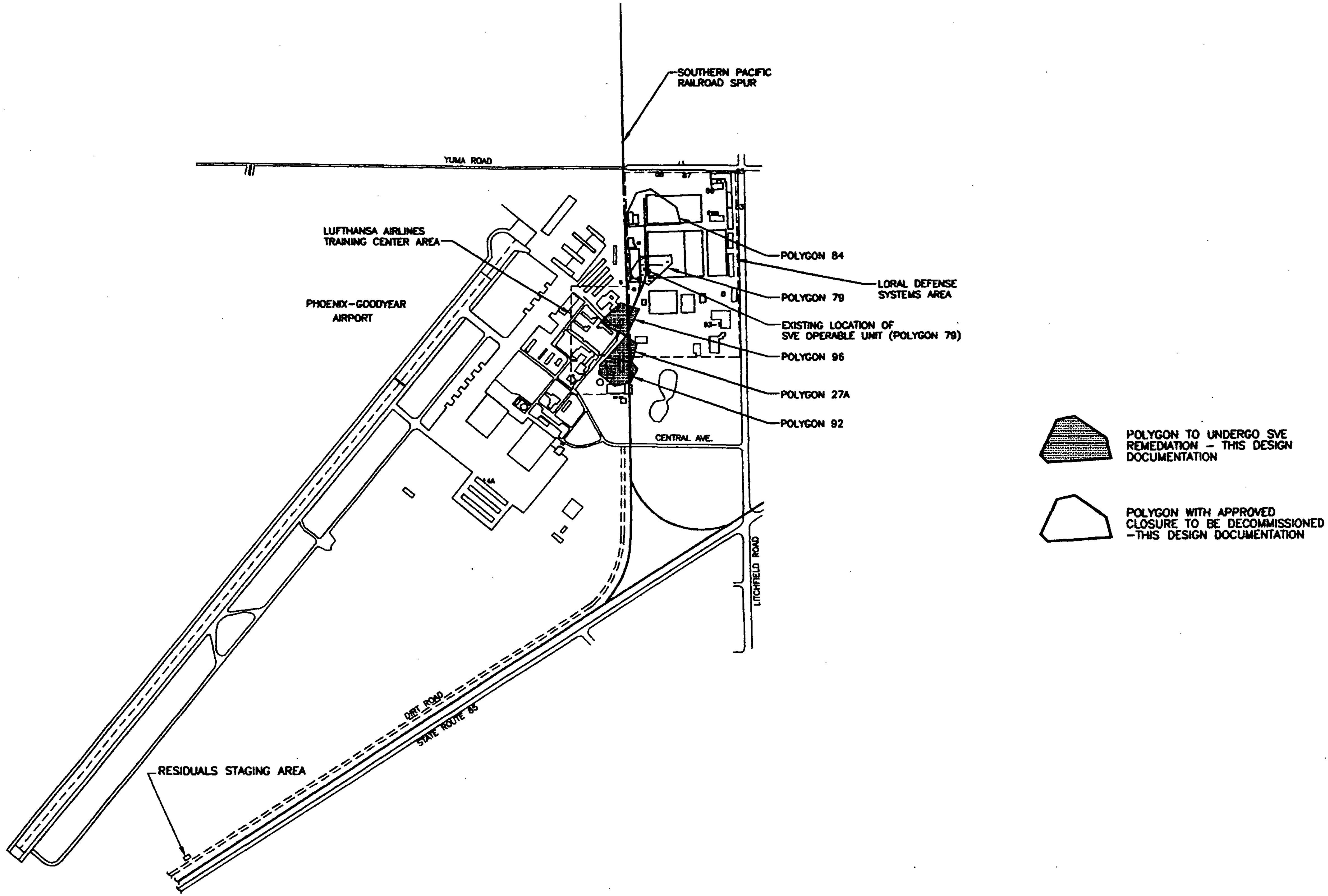
Metcalf & Eddy



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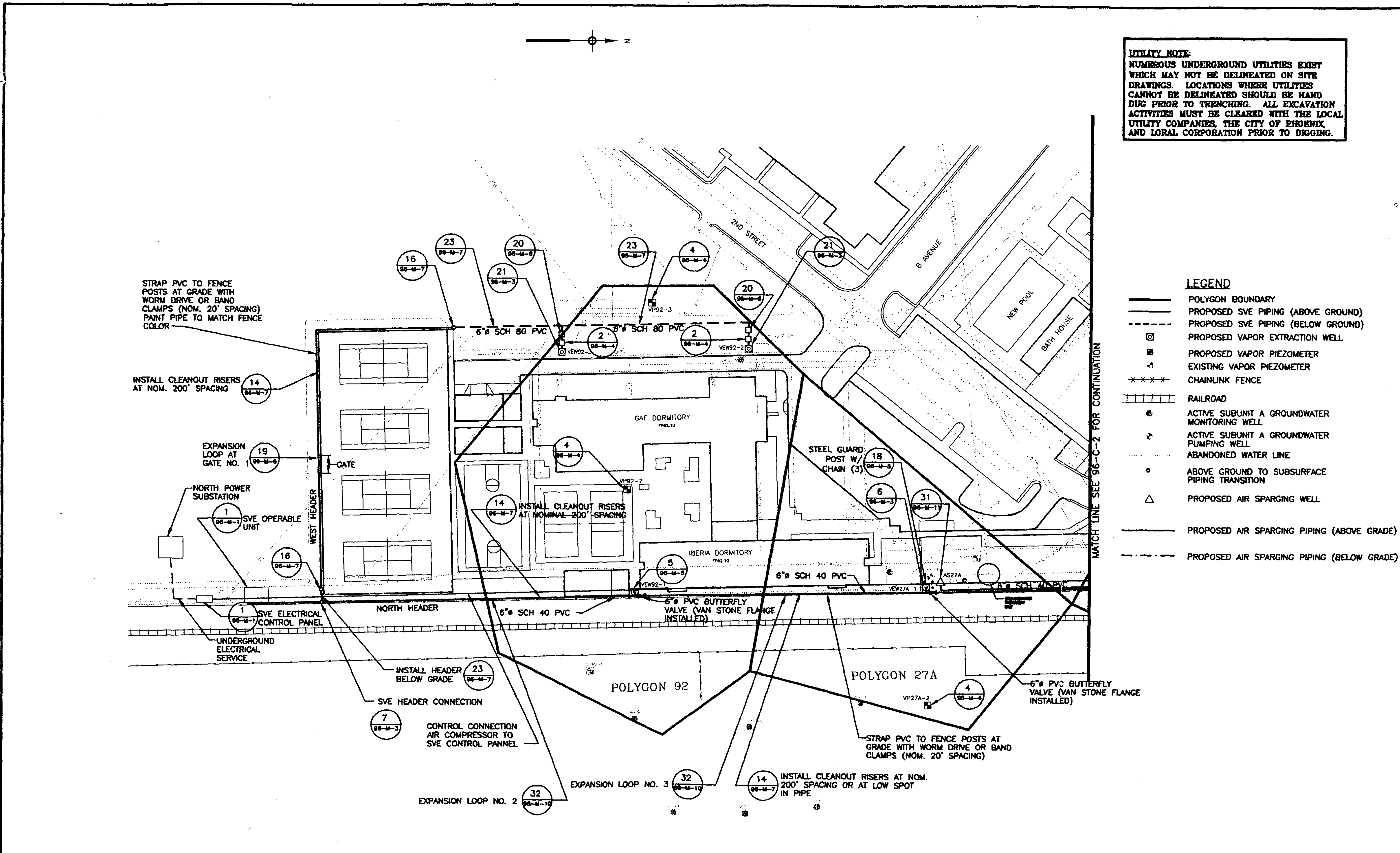
SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A

POLYGON LOCATION MAP

DRAWING NO: 96-P-1
SHEET: 2
OF 23 SHEETS



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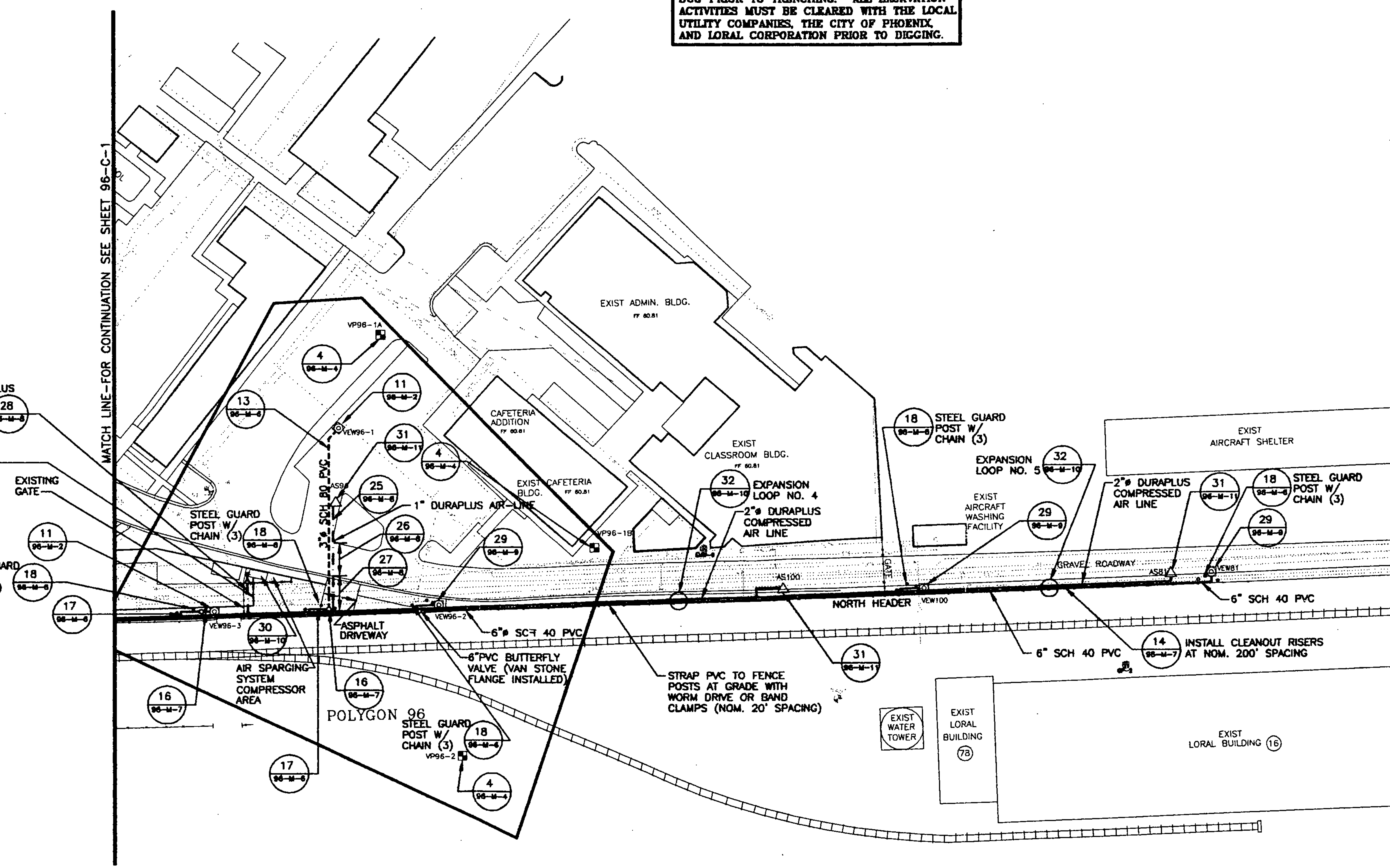
SOIL VAPOR EXTRACTION SYSTEM FINAL DESIGN–POLYGON 96/92/27A	
POLYGON SITE MAP I	
DRAWING NO:	96-C-1
SHEET:	3 of 23 SHEETS

LEGEND

- POLYGON BOUNDARY
- PROPOSED SVE PIPING (ABOVE GROUND)
- PROPOSED SVE PIPING (BELOW GROUND)
- PROPOSED VAPOR EXTRACTION WELL
- PROPOSED VAPOR PIEZOMETER
- EXISTING VAPOR PIEZOMETER
- CHAINLINK FENCE
- RAILROAD
- ACTIVE SUBUNIT A GROUNDWATER MONITORING WELL
- ACTIVE SUBUNIT A GROUNDWATER PUMPING WELL
- ABANDONED WATER LINE
- ABOVE GROUND TO SUBSURFACE PIPING TRANSITION
- PROPOSED AIR SPARGING WELL
- PROPOSED AIR SPARGING PIPING (ABOVE GRADE)
- PROPOSED AIR SPARGING PIPING (BELOW GRADE)

UTILITY NOTE:
NUMEROUS UNDERGROUND UTILITIES EXIST WHICH MAY NOT BE DELINEATED ON SITE DRAWINGS. LOCATIONS WHERE UTILITIES CANNOT BE DELINEATED SHOULD BE HAND DUG PRIOR TO TRENCHING. ALL EXCAVATION ACTIVITIES MUST BE CLEARED WITH THE LOCAL UTILITY COMPANIES, THE CITY OF PHOENIX, AND LORAL CORPORATION PRIOR TO DIGGING.



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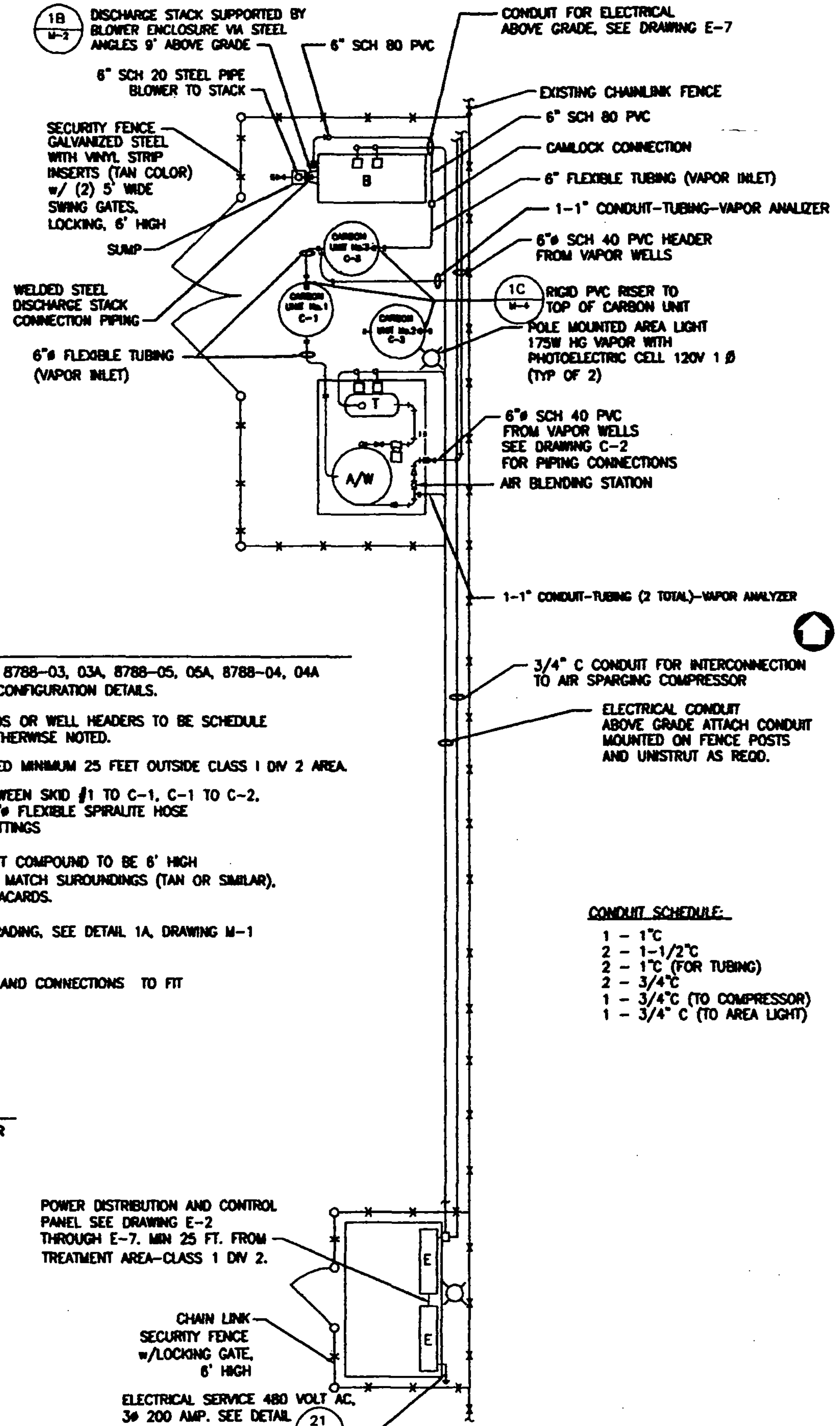
SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A

POLYGON SITE MAP II

DRAWING NO: 96-C-2
SHEET: 4 OF 23 SHEETS



TREATMENT PLANT DETAIL (1)

SCALE: NONE

NOTES:

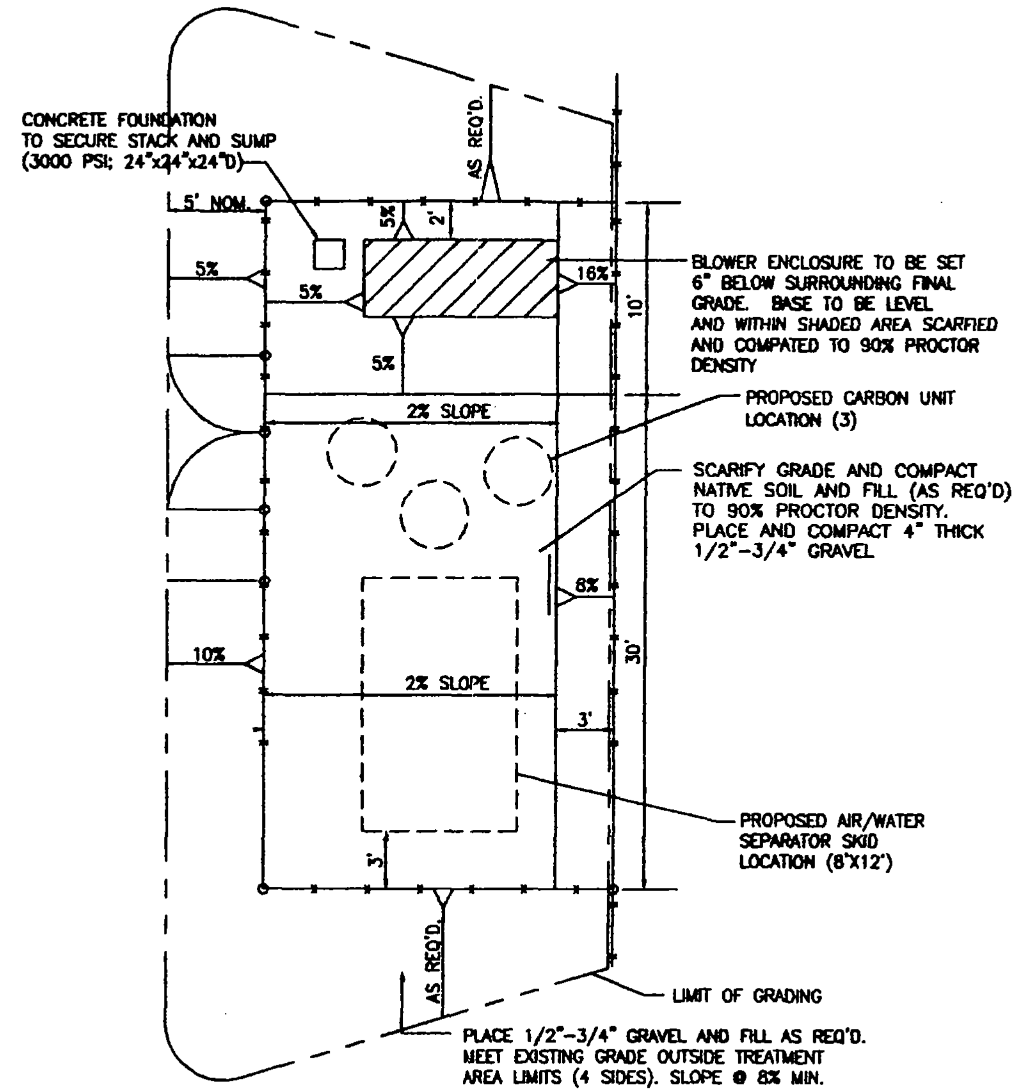
1. REFER TO AFS DRAWINGS 8788-03, 03A, 8788-05, 05A, 8788-04, 04A FOR TREATMENT SYSTEM CONFIGURATION DETAILS.
2. ALL PIPING BETWEEN SKIDS OR WELL HEADERS TO BE SCHEDULE 80 PVC (6"ø) UNLESS OTHERWISE NOTED.
3. ELECTRICAL PANEL LOCATED MINIMUM 25 FEET OUTSIDE CLASS I DIV 2 AREA.
4. PIPING CONNECTIONS BETWEEN SKID #1 TO C-1, C-1 TO C-2, AND C-2 TO B TO BE 6"ø FLEXIBLE SPIRALITE HOSE W/ALUMINUM CAMLOCK FITTINGS
5. FENCE AROUND TREATMENT COMPOUND TO BE 6' HIGH WITH COLORED LATICE TO MATCH SUROUNDINGS (TAN OR SIMILAR), AND SAFETY/SECURITY PLACARDS.
6. fFOR TREATMENT AREA GRADING, SEE DETAIL 1A, DRAWING M-1
7. ADJUST TREATMENT SYSTEM SKID LOCATIONS AND CONNECTIONS TO FIT WITHIN TREATMENT AREA

CONDUIT SCHEDULE:

1 - 1"C
2 - 1-1/2"C
2 - 1"C (FOR TUBING)
2 - 3/4"C
1 - 3/4"C (TO COMPRESSOR)
1 - 3/4" C (TO AREA LIGHT)

LEGEND

A/W= AIR/WATER SEPARATOR
B = BLOWER
C = CONCRETE PAD
C-1 =CARBON VESSEL
T = WATER TANK
P = PUMP
E = ELECTRICAL PAD



TREATMENT AREA GRADING PLAN (1A / -)

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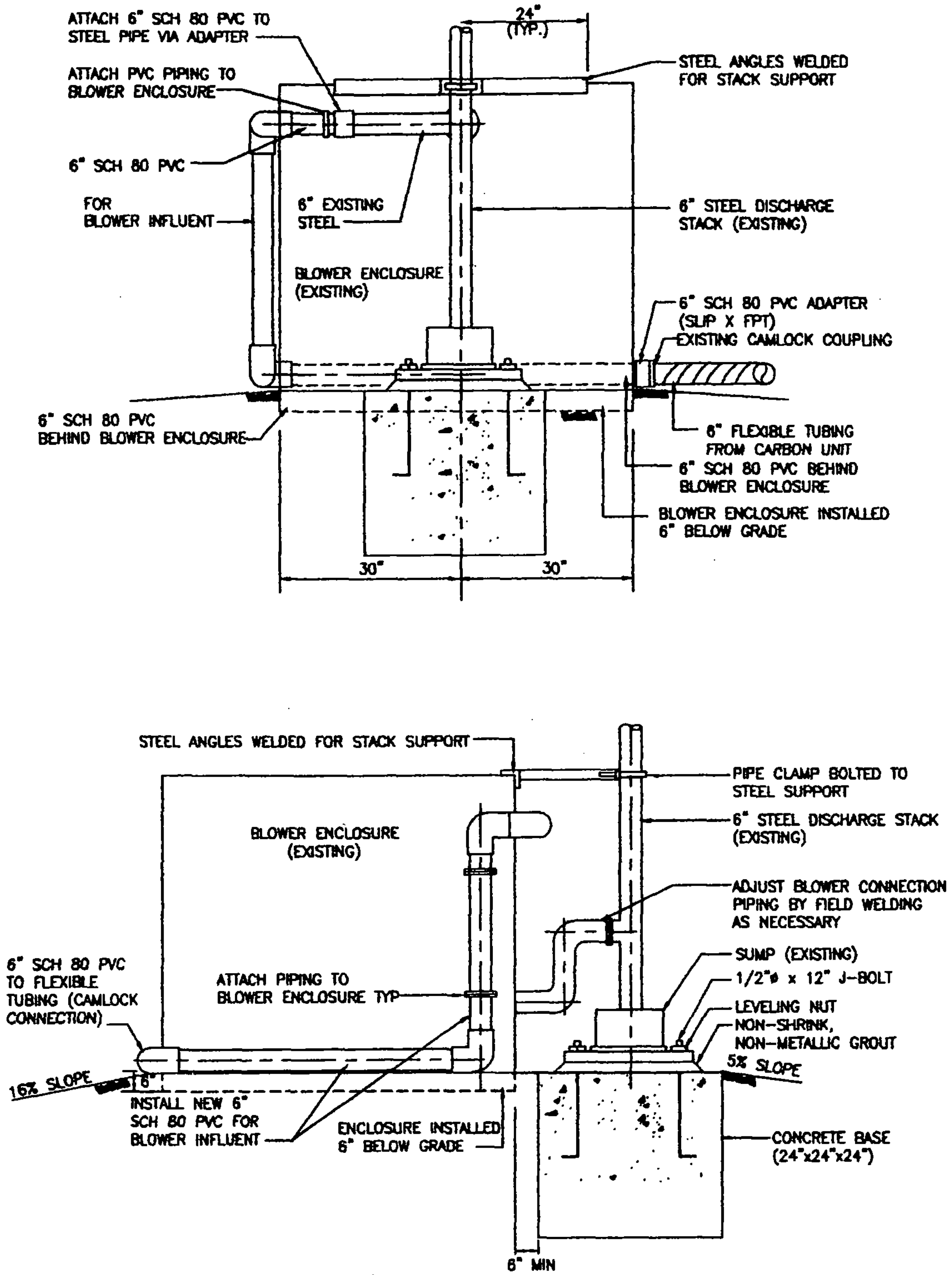
SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A

TREATMENT SYSTEM LAYOUT, PIPING, AND GRADING DETAILS

DRAWING NO: 96-M-1
SHEET: 5 OF 23 SHEETS



BLOWER ENCLOSURE CONNECTION DETAILS (1B)
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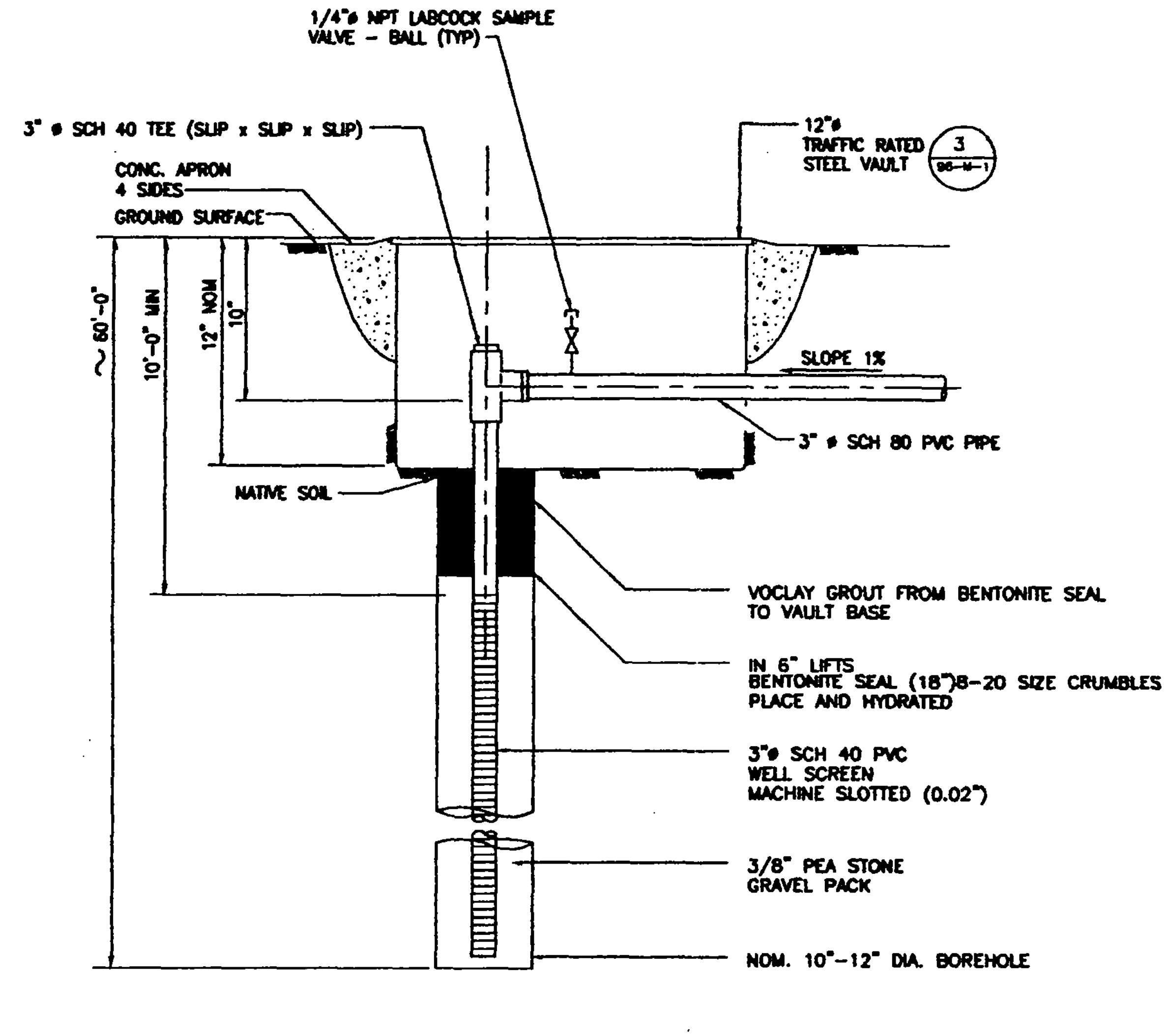

EXTRACTION WELL DETAIL-WELLS VEW 96-1, VEW 96-2, VEW 96-3 (11)
SCALE:NONE

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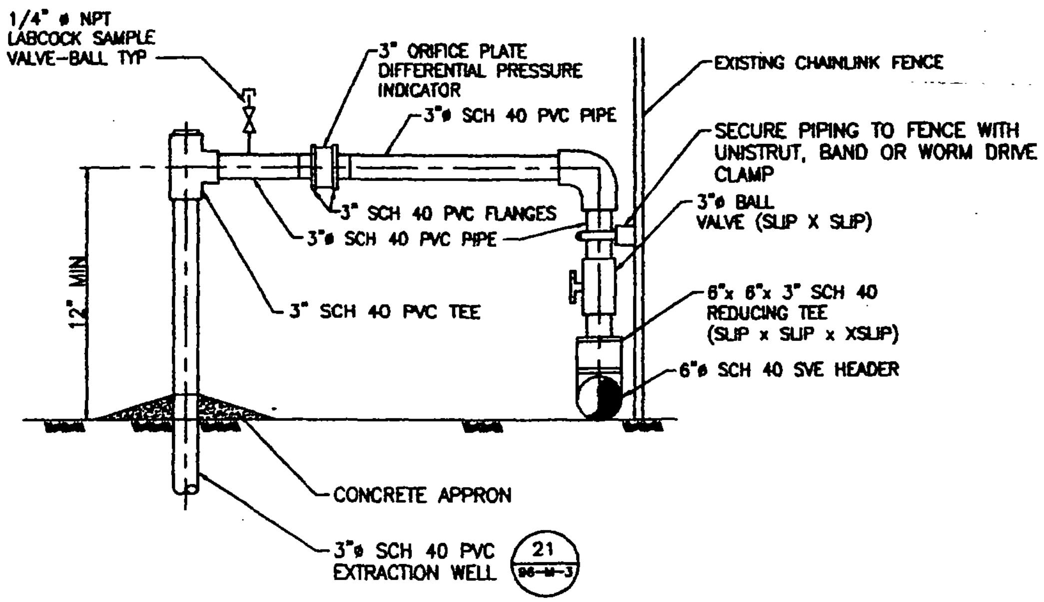
SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A
EXTRACTION WELLS AND PIPING DETAILS I

DRAWING NO: 96-M-2
SHEET 6 of 23 SHEETS



EXTRACTION WELL DETAIL VEW 27A-1 (6)
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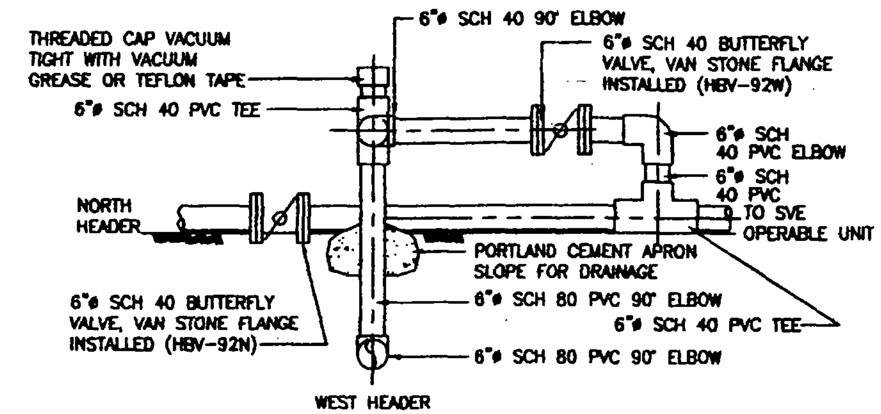

SVE HEADER CONNNECTION DETAIL (7)
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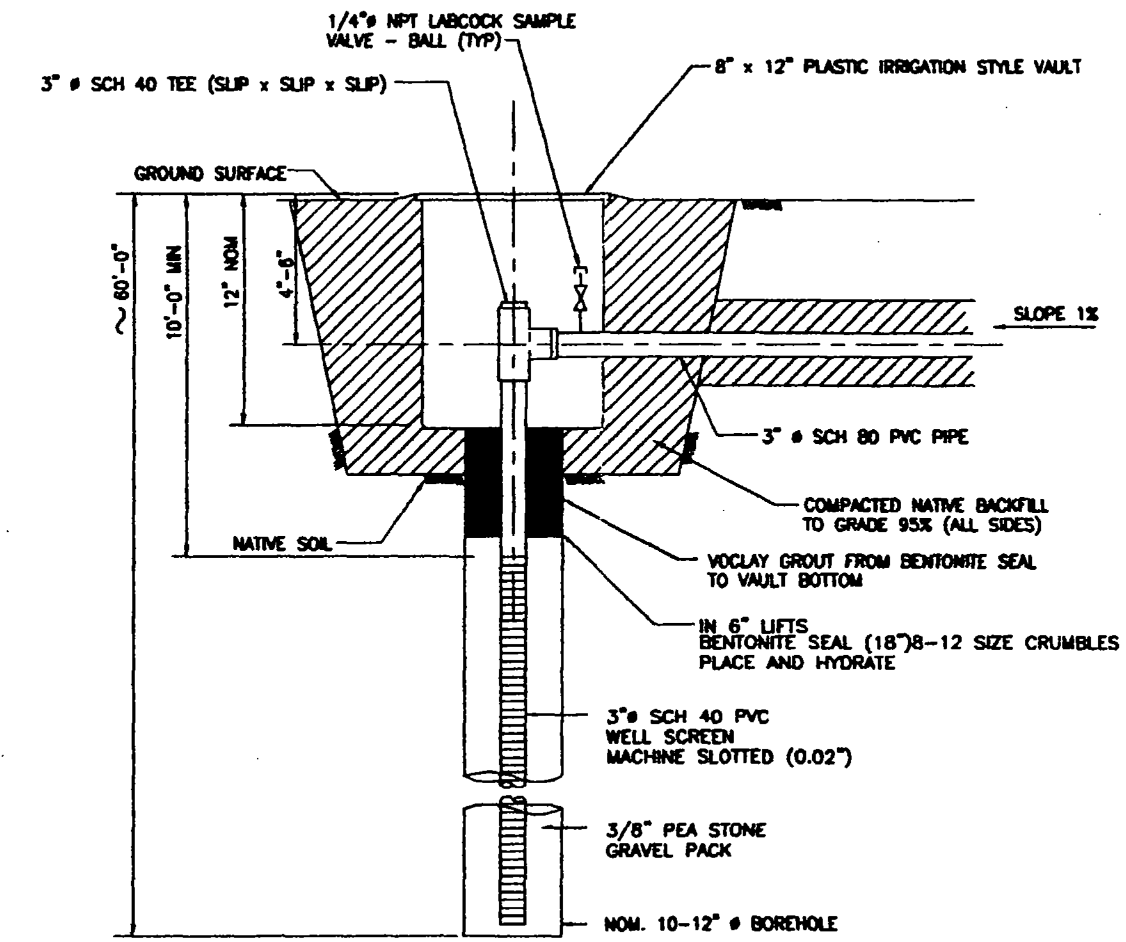

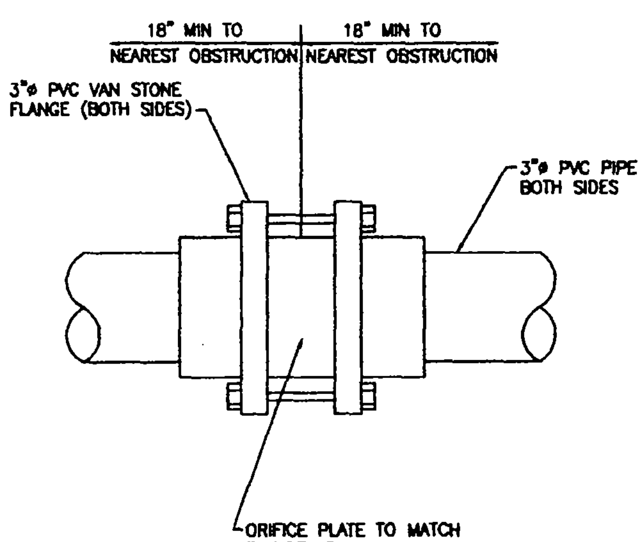

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SCALE: NONE

EXTRACTION WELL DETAIL VEW 92-1, VEW 92-2, VEW 92-3 (21)
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CHECKED SPZ

SCALE: NONE

SAN DIEGO, CA 1995 DATE
CALIF. R.E. No.

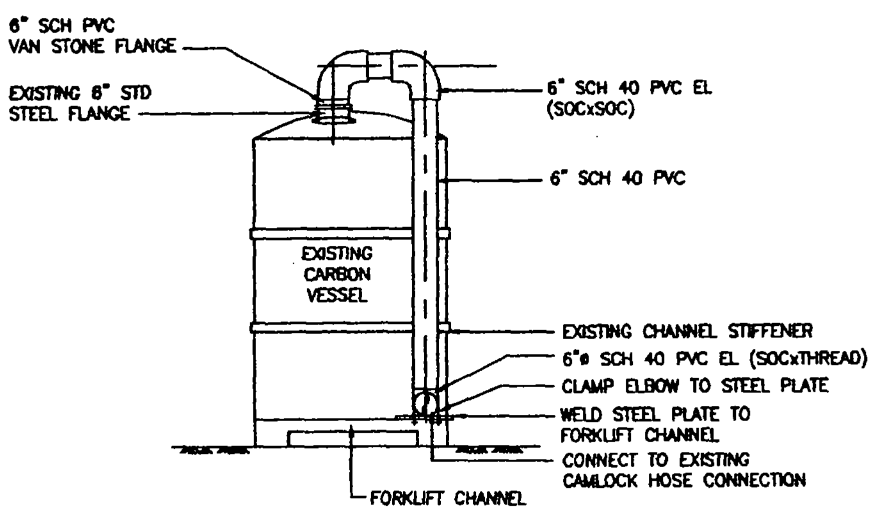
PGA – Goodyear

APPROVED DATE

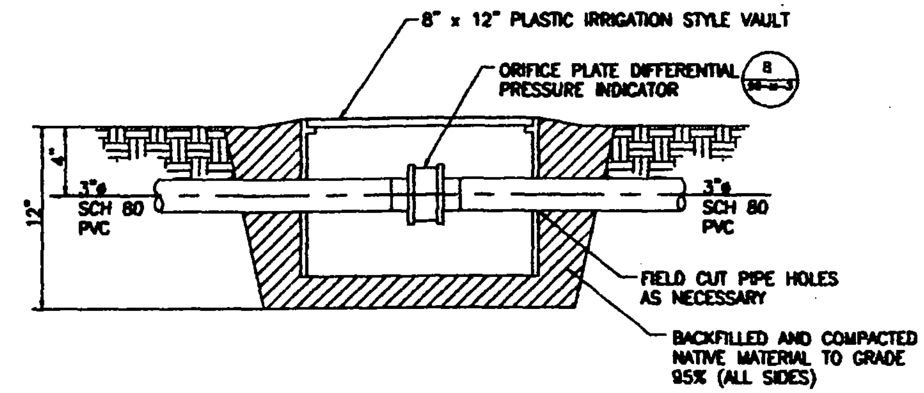
SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A

EXTRACTION WELLS AND
PIPING DETAILS II

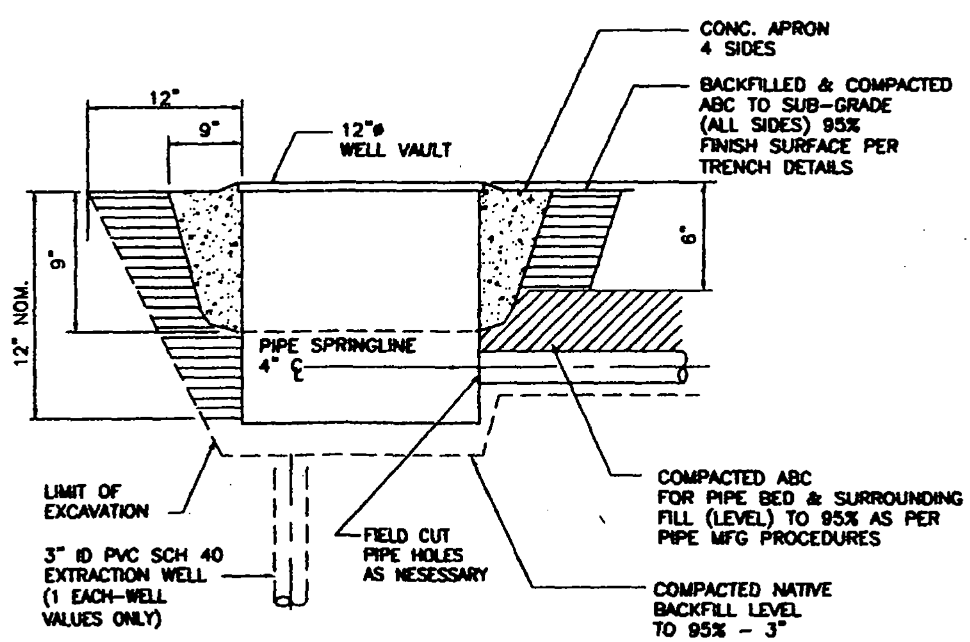
DRAWING NO: 96-M-3
SHEET 7
OF 23 SHEETS



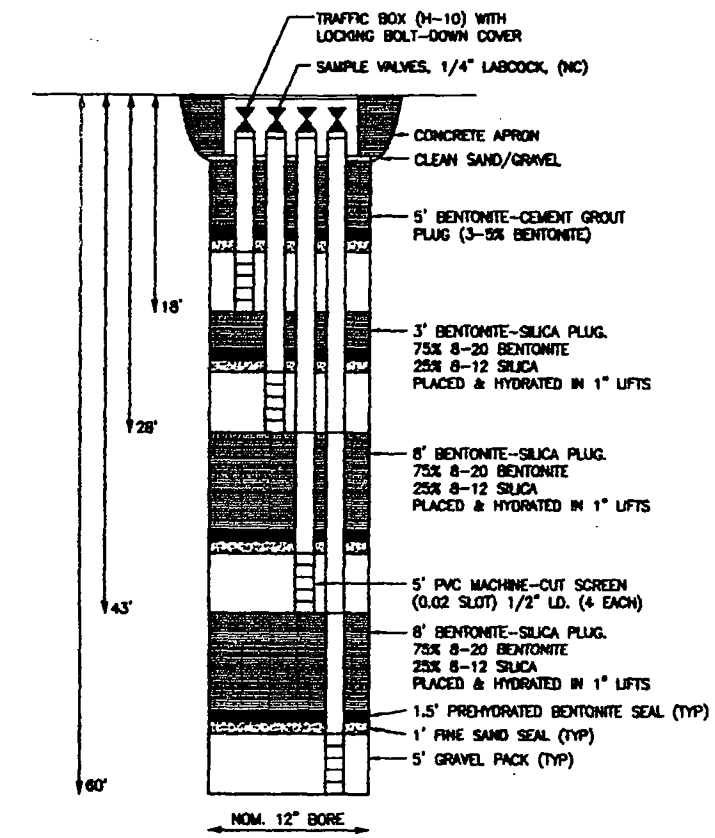
CARBON UNIT RISER DETAIL (1C/—)
SCALE:NONE



ORIFICE PLATE VAULT DETAIL (2)
SCALE: NONE



VAULT INSTALLATION DETAIL (3)
SCALE: NONE



SOIL VAPOR MONITORING WELL DETAIL (4)
SCALE: NONE (CLUSTER CONSTRUCTION)

L:\AUTOCAD\GOODYEAR\96\96_M_4, 9/21/95

NUMBER | DATE | MADE BY | CHECKED | REVISION DESCRIPTION

M&E METCALF & EDDY

DESIGNED KAW
DRAWN GPB
CHECKED SPZ

SCALE: NONE

M&E SAN DIEGO, CA 1995 DATE
CALIF. R.E. No.

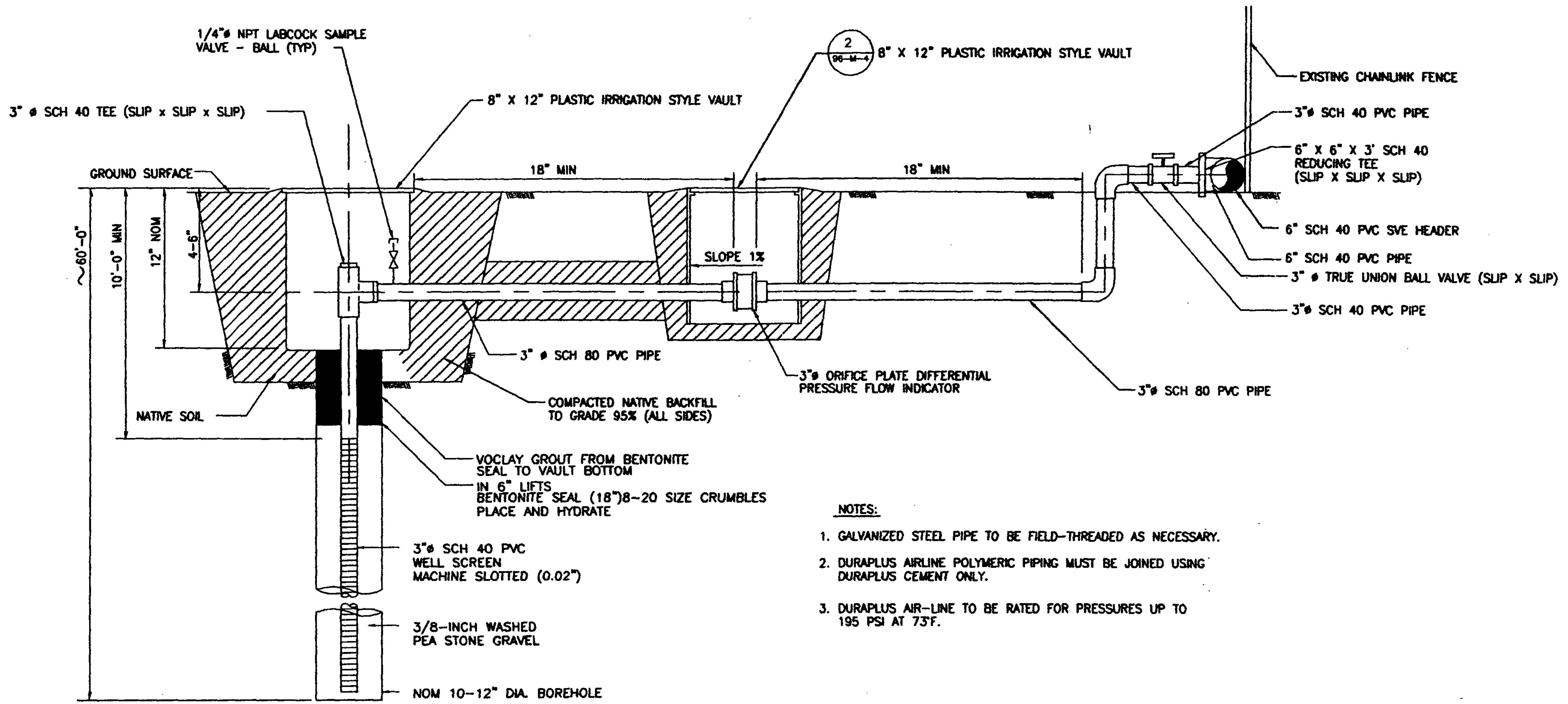
PGA - Goodyear

APPROVED DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A

EXTRACTION WELLS AND
PIPING DETAILS III

DRAWING NO: 96-M-4
SHEET 8
OF 23 SHEETS



NOTES:

1. GALVANIZED STEEL PIPE TO BE FIELD-THREADED AS NECESSARY.
2. DURAPLUS AIRLINE POLYMERIC PIPING MUST BE JOINED USING DURAPLUS CEMENT ONLY.
3. DURAPLUS AIR-LINE TO BE RATED FOR PRESSURES UP TO 195 PSI AT 73°F.

EXTRACTION WELL DETAIL VEW 92-1 (5)
SCALE:NONE

NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION

M&E METCALF & EDDY

DESIGNED KAW
DRAWN GPB
CHECKED SPZ
SCALE:

M&E SAN DIEGO, CA 1995 DATE
CALIF. R.E. No.

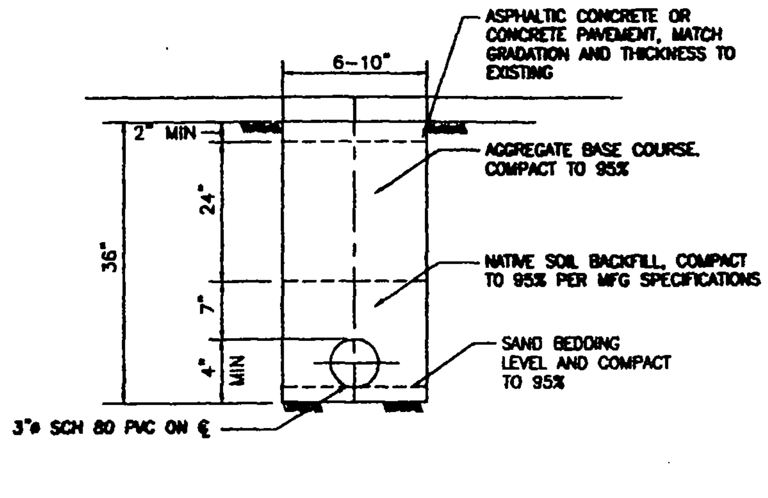
PGA - Goodyear

APPROVED DATE

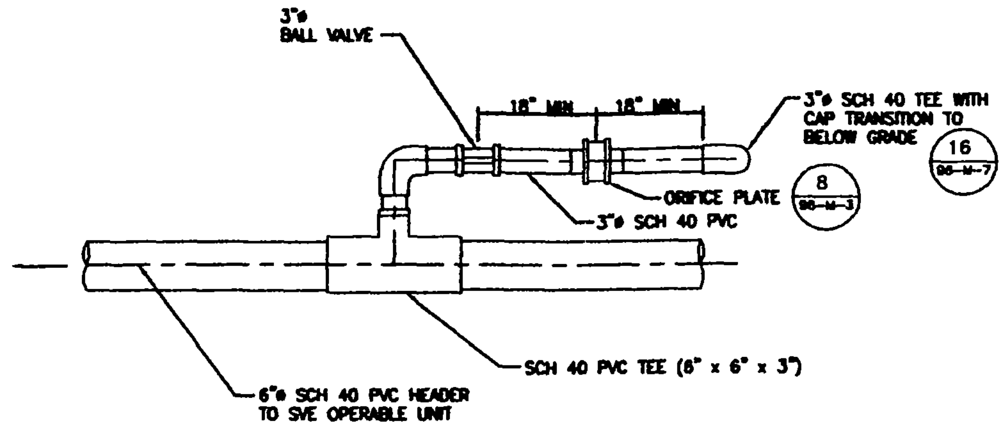
SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A

EXTRACTION WELLS AND PIPING DETAIL IV

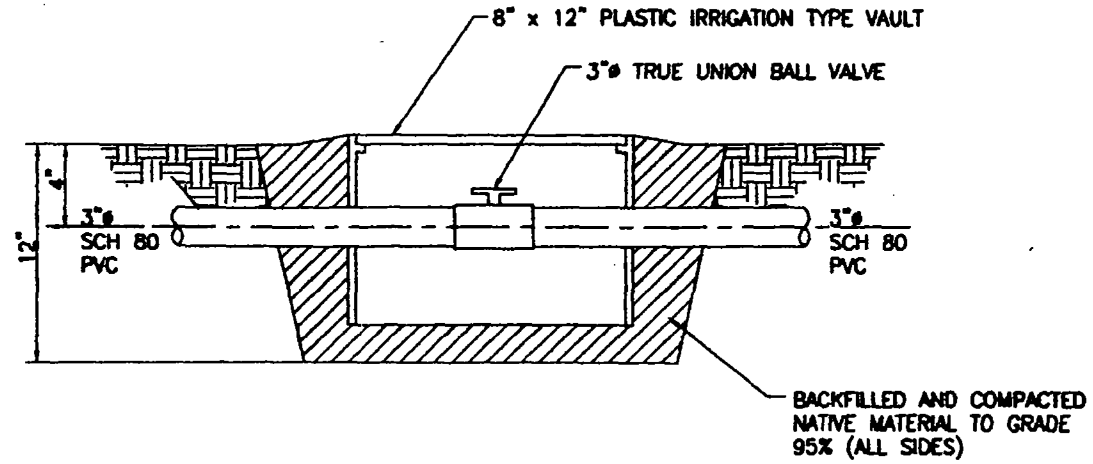
DRAWING NO: 96_M_5
SHEET: 9
OF 23 SHEETS



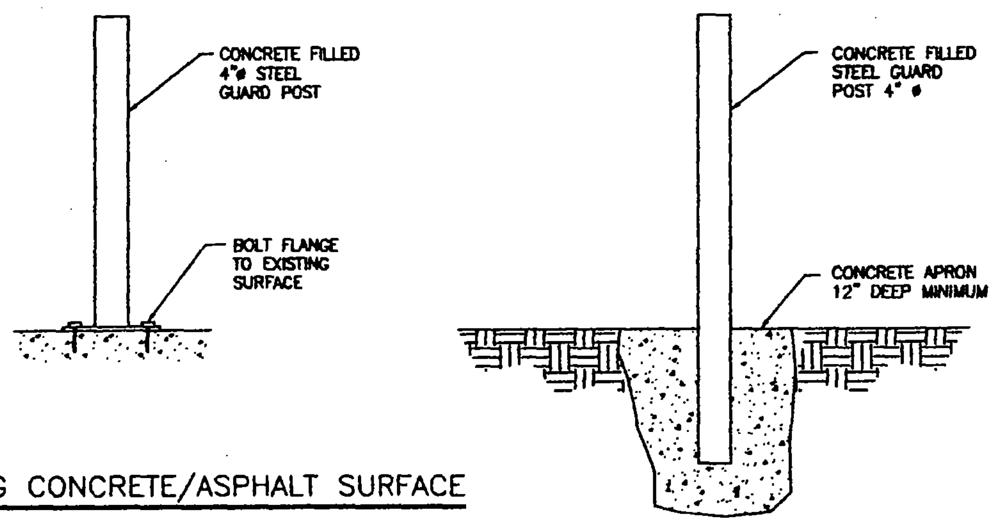
TRENCH SECTION – TRAFFIC AREA (13)
SCALE: NONE REFERENCE: M.A.G. STANDARD DETAIL #200



WELL LATERAL PIPING (17)
SCALE: NONE



VALVE VAULT DETAIL (20)
SCALE: NONE



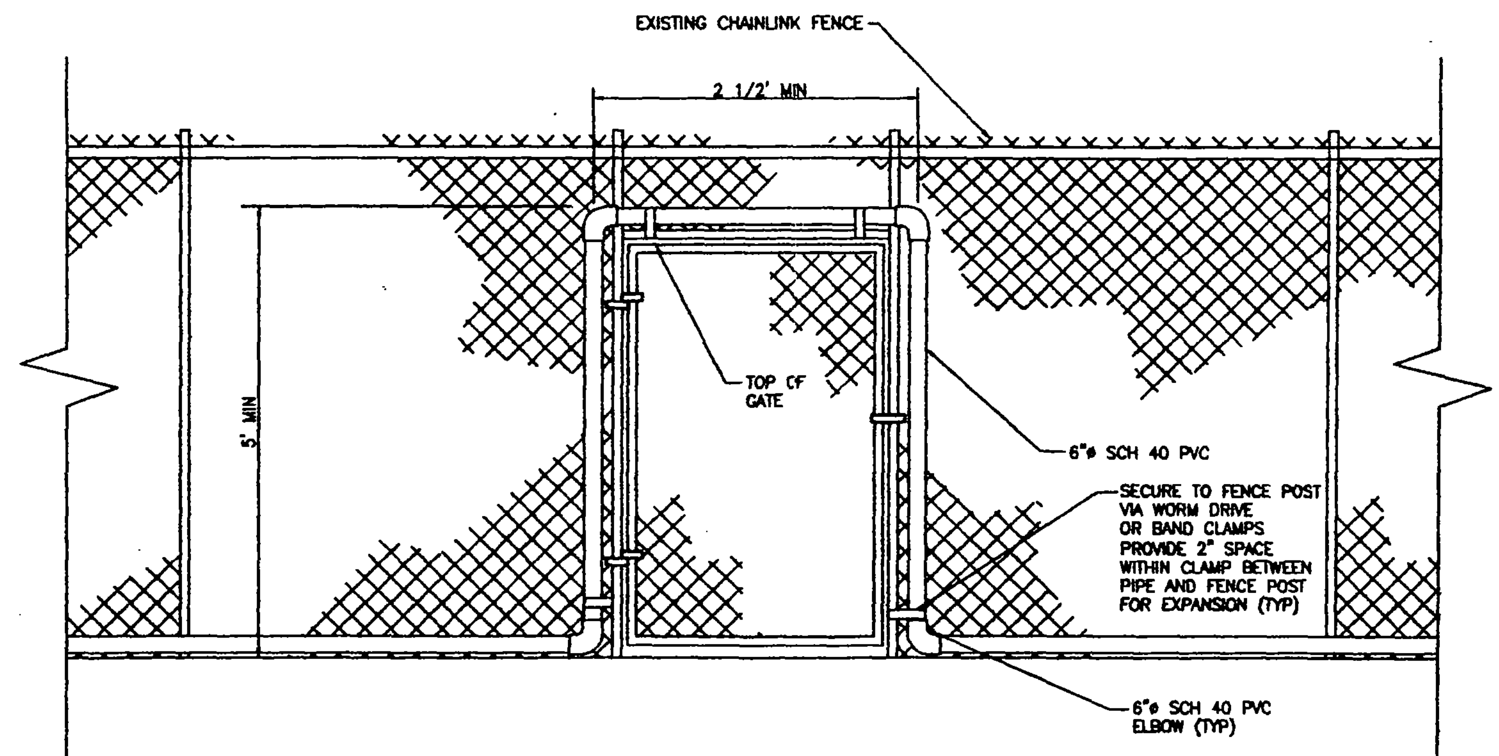
EXISTING CONCRETE/ASPHALT SURFACE

EXISTING GROUND SURFACE

NOTE:

GUARD POSTS TO BE PAINTED SAFETY YELLOW UNLESS OTHERWISE NOTED.

STEEL GUARD POSTS (18)
SCALE: NONE



NOTE:

ALL PIPE ABOVE GRADE SHALL BE FASTENED TO TENNIS COURT FENCE AND PAINTED TO MATCH FENCE COLOR.

EXPANSION LOOP AT GATE (19)
SCALE: NONE

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NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION

M&E METCALF & EDDY

DESIGNED KAW
DRAWN GPB
CHECKED SPZ

SCALE: NONE

SAN DIEGO, CA 1995 DATE
CALIF. R.E. No.

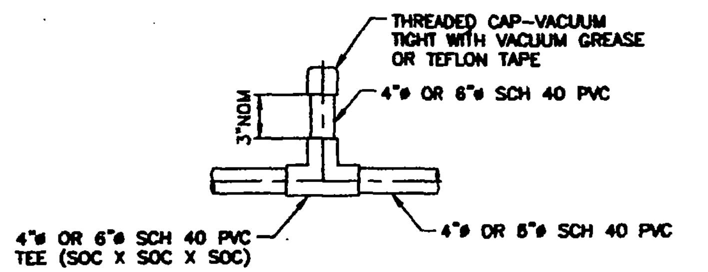
PGA – Goodyear

APPROVED DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN–POLYGON 96/92/27A

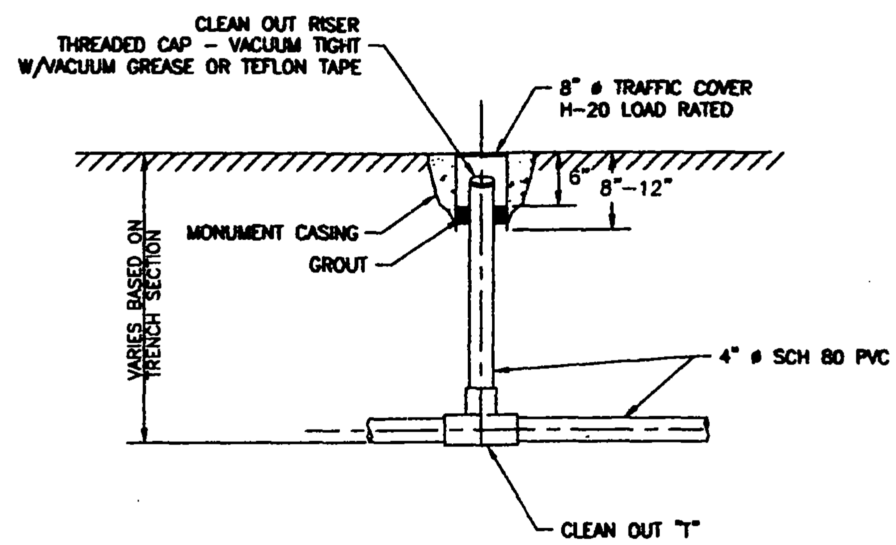
EXTRACTION WELLS AND PIPING DETAILS V

DRAWING NO. 96-M-6
SHEET 10
OF 23 SHEETS

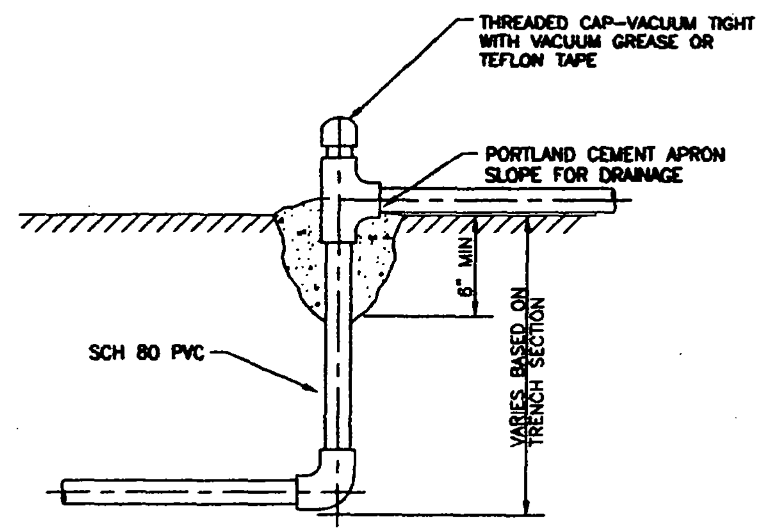


NOTE:
CLEANOUT RISERS TO BE INSTALLED EVERY 200 FEET ALONG ABOVE GROUND PIPE RUNS AT GRADE OR AT LOW POINTS IN PIPE AS REQUIRED.

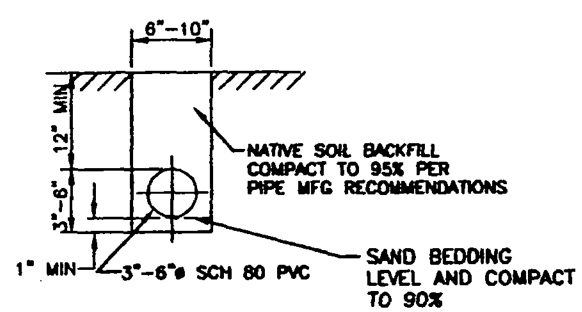
TYPICAL CLEANOUT RISER ABOVE GROUND (14)
SCALE:NONE



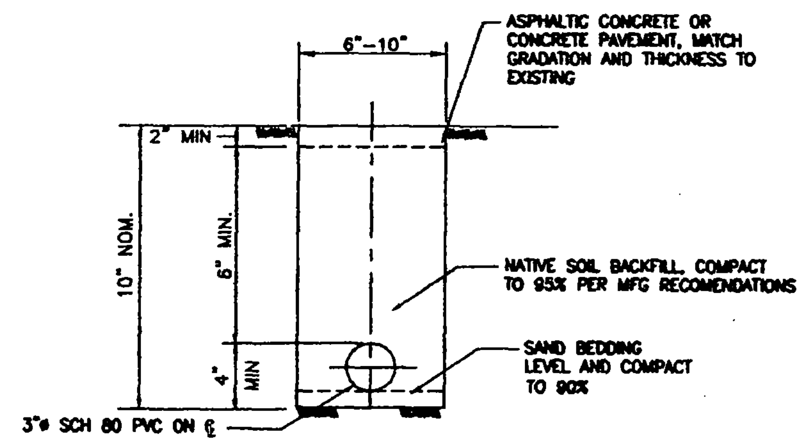
TYPICAL CLEANOUT & RISER BELOW GROUND (15)
SCALE:NONE



DETAIL (16)
SCALE:NONE



TRENCH SECTION – NON-PAVED, NON-TRAFFIC AREA (23)
SCALE:NONE



TRENCH SECTION – PAVED, NON-TRAFFIC AREAS (24)
SCALE: NONE

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NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION

M&E METCALF & EDDY

DESIGNED KAW
DRAWN GPB
CHECKED SPZ

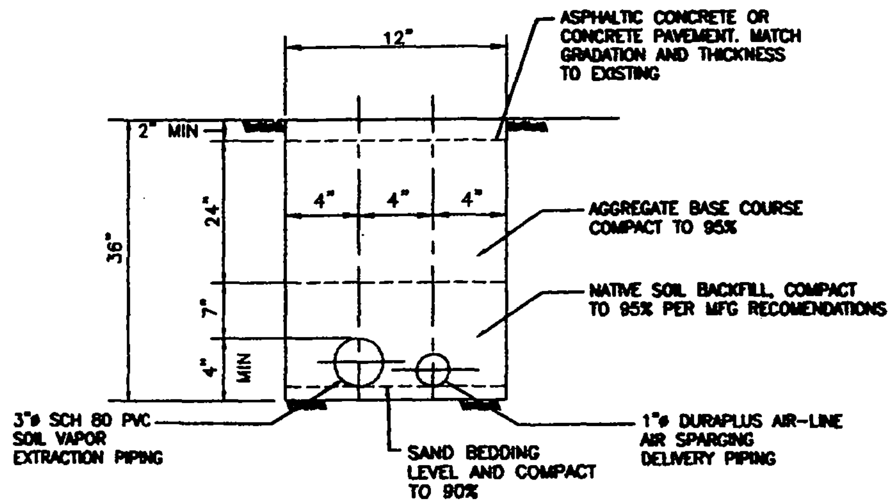
SCALE: NONE

SAN DIEGO, CA 1995 DATE
CALIF. R.E. No.

PGA – Goodyear
APPROVED DATE

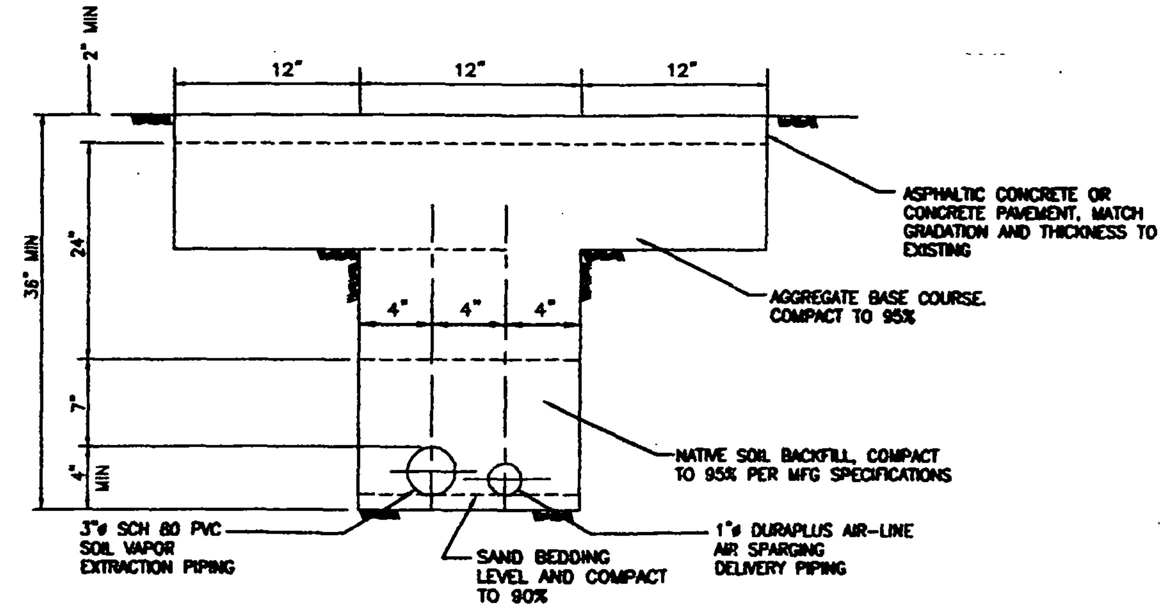
SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A
EXTRACTION WELLS AND PIPING DETAILS VI

DRAWING NO: 96-M-7
SHEET: 11
OF 23 SHEETS



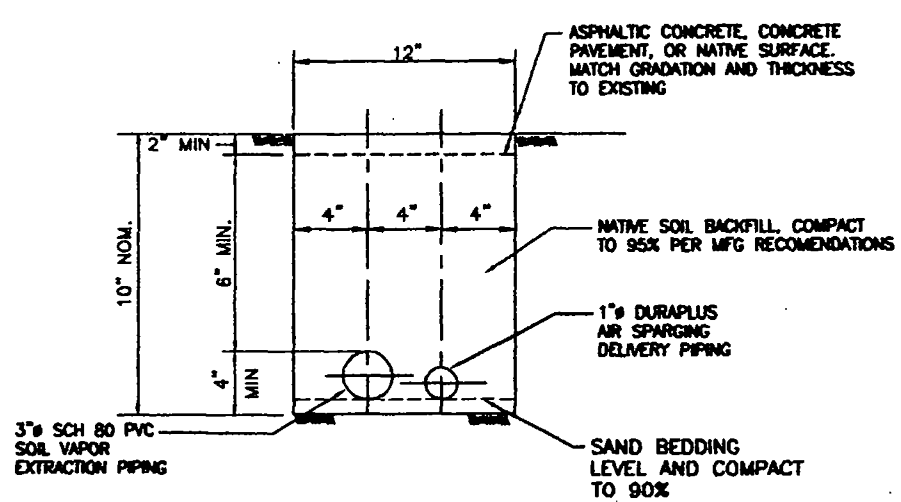
TRENCH SECTION – TRAFFIC AREA (25)

SCALE: NONE REFFERENCE: M.A.G. STANDARD DETAIL #200



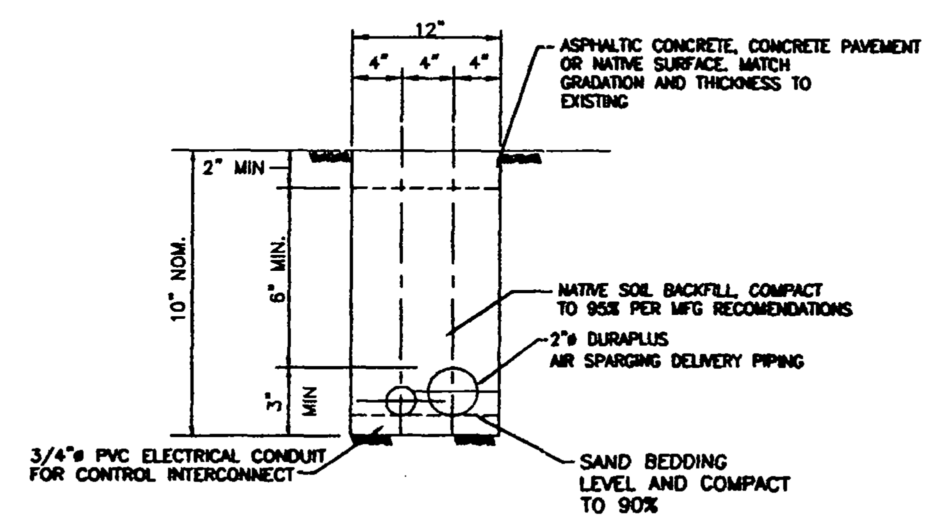
TRENCH SECTION – TRAFFIC AREA NOT PARALLEL TO CENTERLINE (26)

SCALE: NONE REFERENCE: M.A.G. STANDARD DETAIL #200



TRENCH SECTION – NON-TRAFFIC AREAS (27)

SCALE: NONE



TRENCH SECTION – NON-TRAFFIC AREAS (28)

SCALE: NONE

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NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION

METCALF & EDDY

DESIGNED KAW
DRAWN GPB
CHECKED SPZ

SCALE: NONE

M&E SAN DIEGO, CA 1995 DATE
CALIF. R.E. No.

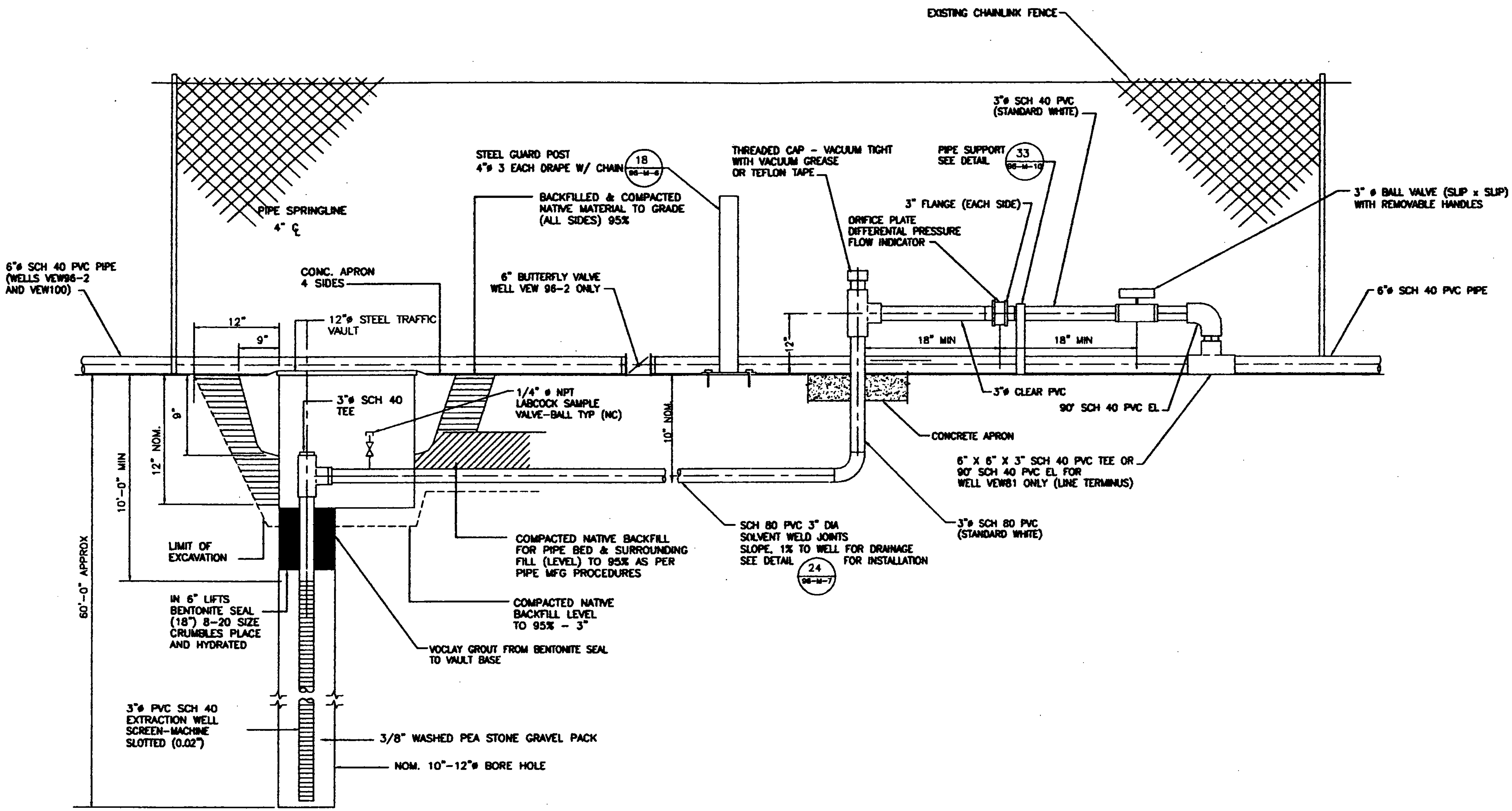
PGA – Goodyear

APPROVED DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN–POLYGON 96/92/27A

AIR SPARGING DETAILS – I

DRAWING NO: 96-M-8
SHEET: 12 of 23 SHEETS



EXTRACTION WELL DETAIL
VEW96-2, VEW100, VEW81 (29)
SCALE:NONE

L:\AUTOCAD\GOODYEAR\96\96_M_9, 9/21/95

NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION

M&E METCALF & EDDY

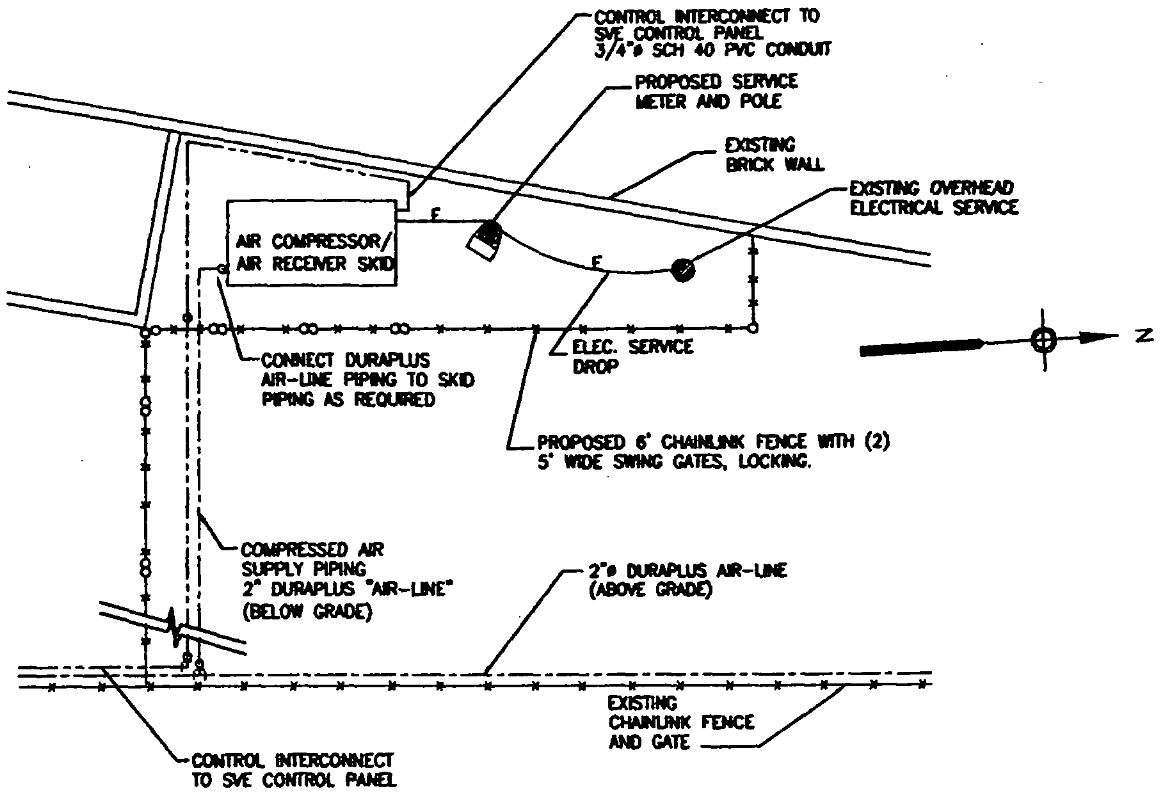
DESIGNED KAW
DRAWN GPB
CHECKED SPZ
SCALE: NONE

M&E SAN DIEGO, CA 1995 DATE
CALIF. R.E. No.

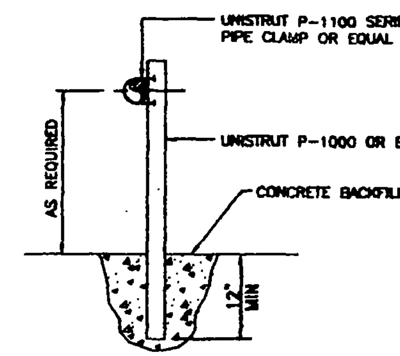
PGA - Goodyear
APPROVED DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A
AIR SPARGING
DETAILS - II

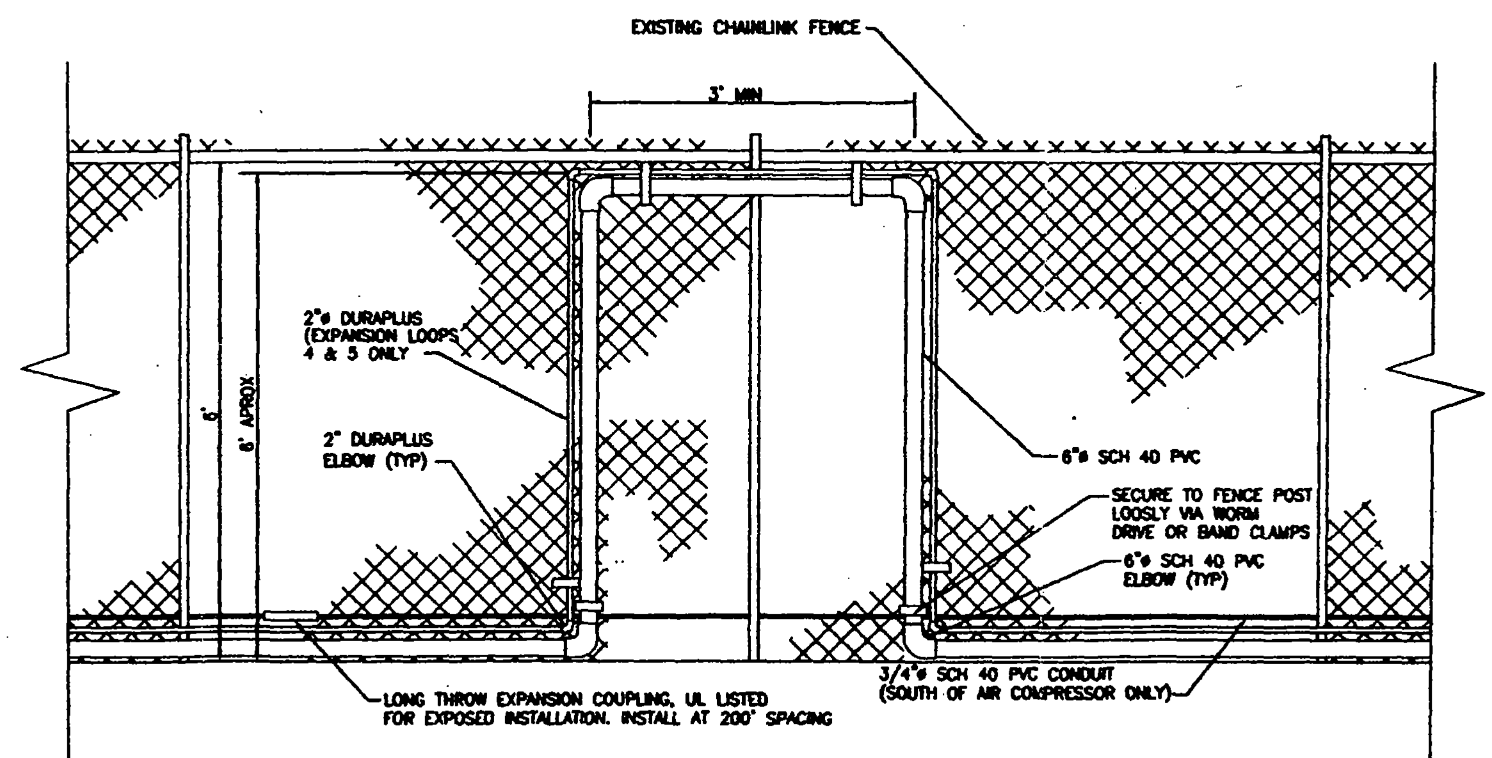
DRAWING NO: 96-M-9
SHEET: 13
OF 23 SHEETS



AIR SPARGING SYSTEM
COMPRESSOR AREA (30)
NO SCALE



PIPE SUPPORT (33)
NO SCALE



NOTE:
ALL ABOVE GRADE PVC PIPE SHALL BE FASTENED TO FENCE AND PAINTED TO MATCH FENCE COLOR.

EXPANSION LOOP AT RAILROAD FENCE (32)
SCALE: NONE

L:\AUTOCAD\GOODYEAR\96\96_M_10, 9/21/95

NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION

M&E METCALF & EDDY

DESIGNED KAW
DRAWN GPB
CHECKED SPZ

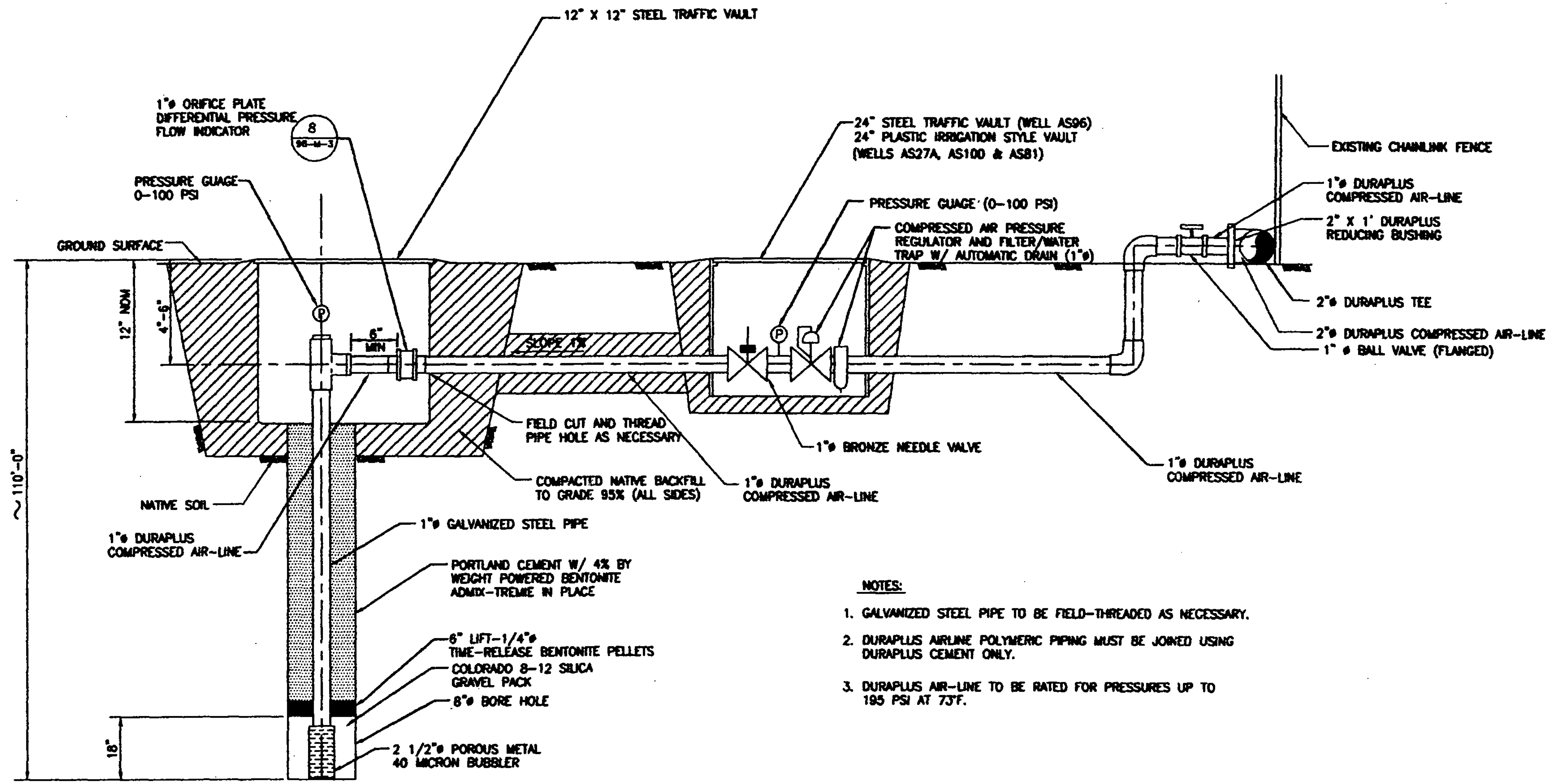
SCALE: NONE

M&E SAN DIEGO, CA 1995 DATE
CALIF. R.E. No.

PGA - Goodyear
APPROVED DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A
AIR SPARGING
DETAILS - III

DRAWING NO: 96-M-10
SHEET: 14
OF 23 SHEETS



NOTES:

1. GALVANIZED STEEL PIPE TO BE FIELD-THREADED AS NECESSARY.
2. DURAPLUS AIRLINE POLYMERIC PIPING MUST BE JOINED USING DURAPLUS CEMENT ONLY.
3. DURAPLUS AIR-LINE TO BE RATED FOR PRESSURES UP TO 195 PSI AT 73°F.

AIR SPARGE WELL DETAIL (31)
SCALE:NONE

C:\GOODYEAR\96\96_M_11.DWG, 9/21/95

NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION

M&E METCALF & EDDY

DESIGNED KAW
DRAWN GPB
CHECKED SPZ

SCALE: NONE

M&E SAN DIEGO, CA 1995 DATE
CALIF. R.F. No.

PGA – Goodyear

APPROVED DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A

AIR SPARGING
DETAILS IV

DRAWING NO: 96-M-11
SHEET 15
OF 23 SHEETS

PROCESS FLOW AND INSTRUMENTATION DIAGRAM SYMBOLS

MEANINGS OF IDENTIFICATION LETTERS

THIS TABLE APPLIES ONLY TO THE FUNCTIONAL IDENTIFICATION OF INSTRUMENTS

INSTRUMENT & DEVICE LETTERING TABLE

LETTER	FIRST LETTER VARIABLE	SECOND AND SUCCEEDING LETTERS
A	ANALYSIS	ALARM
B	BURNER FLAME	CLOSE OR DECREASE
C	CONDUCTIVITY	CONTROL
D	DENSITY	OPEN OR INCREASE
E	VOLTAGE (EMF)	PRIMARY ELEMENT
F	FLOW RATE	FAILURE
G	USER CHOICE	
H	HAND (MANUAL)	HIGH
I	CURRENT (ELECT)	INDICATE
J	POWER	LIGHT
K	TIME	CONTROL STATION
L	LEVEL	LOW
M	MOTOR	OPERATE OR ON/OFF
N	MOISTURE	START/STOP OR OPEN/CLOSE
O	TORQUE	OVERLOAD
P	PRESSURE OR VACUUM	
Q	COMMON	TOTALIZE
R	RADIOACTIVITY	RECORDER
S	SPEED OR FREQUENCY	SWITCH, SAMPLE
T	TEMPERATURE	TRANSMITTER
U	MULTIVARIABLE	MULTIFUNCTION
V	VALVE OR DAMPER, VAPOR	
W	WEIGHT OR FORCE	
X	VIBRATION, MOTION	EXCESS
Y	COMPUTER	RELAY OR CONTROL
Z	POSITION	DRIVE, ACTUATE OR FINAL CONTROL ELEMENT

INSTRUMENT LINES

- CONNECTION TO PROCESS, OR MECHANICAL LINK, OR INSTRUMENT SUPPLY
- ELECTRICAL SIGNAL
- (E) ELECTRICAL POWER, 115 V, 60 Hz
- PNEUMATIC SIGNAL
- ELECTRICAL INTERLOCK SEE ELECTRICAL WIRING DIAGRAM

- CHECK VALVE
- GATE VALVE
- GLOBE VALVE
- SWING CHECK VALVE
- BUTTERFLY VALVE
- NEEDLE VALVE
- VACUUM RELIEF VALVE
- M — MOTOR
- REDUCER
- NIC — NOT IN CONTRACT
- NO — NORMALLY OPEN
- NC — NORMALLY CLOSED
- PITOT TUBE
- CENTRIFUGAL PUMP
- POSITIVE DISPLACEMENT BLOWER
- TELEMETRY ANALOG INPUT
- TELEMETRY ANALOG OUTPUT
- TELEMETRY CONTACT INPUT
- TELEMETRY CONTACT OUTPUT
- AIR FILTER
- SG 506 — SITE GLASS
- SAMPLE TAP
- AIC 506 — FIRST LETTER; SUCCEEDING LETTERS (SEE TABLE ABOVE); LOOP NUMBER
- AT 506 — FIELD MOUNTED INSTRUMENT
- AR 506 pH — PANEL MOUNTED INSTRUMENT
- PANEL MOUNTED BEHIND THE BOARD
- HOA — HAND-OFF-AUTOMATIC
- SS — START-STOP

ONE LINE & CONTROL DIAGRAM SYMBOLS

- 15/100 — MOLDED CASE CIRCUIT BREAKER, THERMAL MAGNETIC TRIP, 3 - POLE UNO, UPPER NUMERAL INDICATES TRIP SETTING, LOWER NUMERAL INDICATES FRAME SIZE.
- 3/MCP — MOTOR CIRCUIT PROTECTOR, NUMERAL INDICATES CONTINUOUS CURRENT RATING.
- 3 — CT = CURRENT TRANSFORMER, NUMERAL DENOTES QUANTITY
- TRANSFORMER, RATING AND VOLTAGE AS SHOWN
- MAGNETIC STARTER
  - FVNR 2
  - FVNR = FULL VOLTAGE, NON-REVERSING
  - FVR = FULL VOLTAGE, REVERSING
  - RVAT = REDUCED VOLTAGE, NON-REVERSING AUTO-TRANSFORMER TYPE
  - RVSS = REDUCED VOLTAGE SOLID STATE
  - VFD = VARIABLE FREQUENCY DRIVE
  - C = MAGNETIC CONTACTOR (WITHOUT O.L.)
  - NUMERAL INDICATES NEMA SIZE
- COMPONENT OUTLINE
- 5 — SQUIRREL CAGE INDUCTION MOTOR, HORSEPOWER INDICATED
- GROUND
- CONDUCTOR CROSSING - NOT CONNECTED
- CONDUCTOR CROSSING - CONNECTED
- OVERLOAD HEATERS
- FUSE
- CONTROL POWER TRANSFORMER
- THREE POSITION SWITCH H-O-A HAND-OFF-AUTOMATIC
- NORMALLY OPEN CONTACT - COIL DEENERGIZED
- NORMALLY CLOSED CONTACT - COIL DEENERGIZED
- FIELD MOUNTED EQUIPMENT
- POWER DISTRIBUTION MODULE TERMINALS
- INSTRUMENT TERMINALS
- TELEMETRY TERMINALS
- LIMIT SWITCH
- LOCKOUT STOP MOMENTARY TYPE PUSHBUTTON
- MOMENTARY PUSHBUTTON--NORMALLY CLOSED
- MOMENTARY PUSHBUTTON--NORMALLY OPEN
- NORMALLY OPEN, TIME DELAY CLOSE - ON DELAY
- NORMALLY CLOSED, TIME DELAY OPEN - OFF DELAY
- FLOAT SWITCH
- PRESSURE SWITCH, NORMALLY CLOSED OPENS ON RISING PRESSURE
- G — INDICATING LAMP A=AMBER, G=GREEN, R=RED, W=WHITE
- M OL'S — MAGNETIC CONTACTOR COIL WITH OVERLOAD CONTACTS
- TDR — TIME DELAY RELAY COIL
- ETM — ELAPSED TIME METER
- FUSE, RATING INDICATED
- 200A — DISCONNECT SWITCH, NUMERAL INDICATES RATING
- EYS (EXPLOSION PROOF) SEAL

PLAN SYMBOLS

- M — INDUCTION MOTOR - FOR HORSEPOWER RATING SEE PANELBOARD SCHEDULE OR ONE LINE DIAGRAGM
- PUSHBUTTON OR CONTROL SWITCH IN NEMA 4 ENCLOSURE. SEE CONTROL DIAGRAMS. SEE DETAILS FOR MOUNTING. (4 = NEMA 4 ENCLOSURE, ETC)
- CONDUIT RUN. IF UNMARKED, CONDUIT IS 3/4" 2#12 CIRCUIT WIRES, 1#12 GROUND WIRE. CROSS LINES INDICATE NUMBER OF #12 WIRES IF MORE THAN TWO. LONG CROSS LINE INDICATES GROUND. SIZE CONDUIT PER NEC.
- LA-2 — HOME RUN FROM DEVICE TO PANEL LA CIRCUIT NO. 2
- CONDUIT TURNING UP OR TOWARD OBSERVER
- CONDUIT TURNING DOWN OR AWAY FROM OBSERVER
- CONDUIT RUNS EXPOSED
- T — CONDUIT FOR TELEPHONE COMPANY'S WIRING
- CONCEALED CONDUIT UNLESS NOTED OTHERWISE
- G — GROUND WIRE
- E — CONCEALED CONDUIT IN CONCRETE DUCT BANK
- CONDUIT (EMPTY) STUBBED OUT AND CAPPED
- LIQUID TIGHT FLEXIBLE CONDUIT
- GROUND ROD
- J — JUNCTION BOX - NEMA 1, NEMA 4 OUTDOORS
- PIT 508 — INSTRUMENT CALLOUT - SEE INSTRUMENTATION SYMBOL LIST FOR IDENTIFICATION. **

** WIRING ONLY BY ELECTRICAL CONTRACTOR

NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION
1	2/94	SZ		POLYGON 84 DESIGN

METCALF & EDDY

DESIGNED ____ DRAWN ____ CHECKED ____ SCALE: NONE

SAN DIEGO, CA — 1994 DATE

CALIF. R.E. No.

PGA - Goodyear

APPROVED ____ DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN - POLYGON 96/92/27A

ELECTRICAL AND INSTRUMENTATION SYMBOLS

DRAWING NO: 96-E-1
SHEET: 16 of 23 SHEETS

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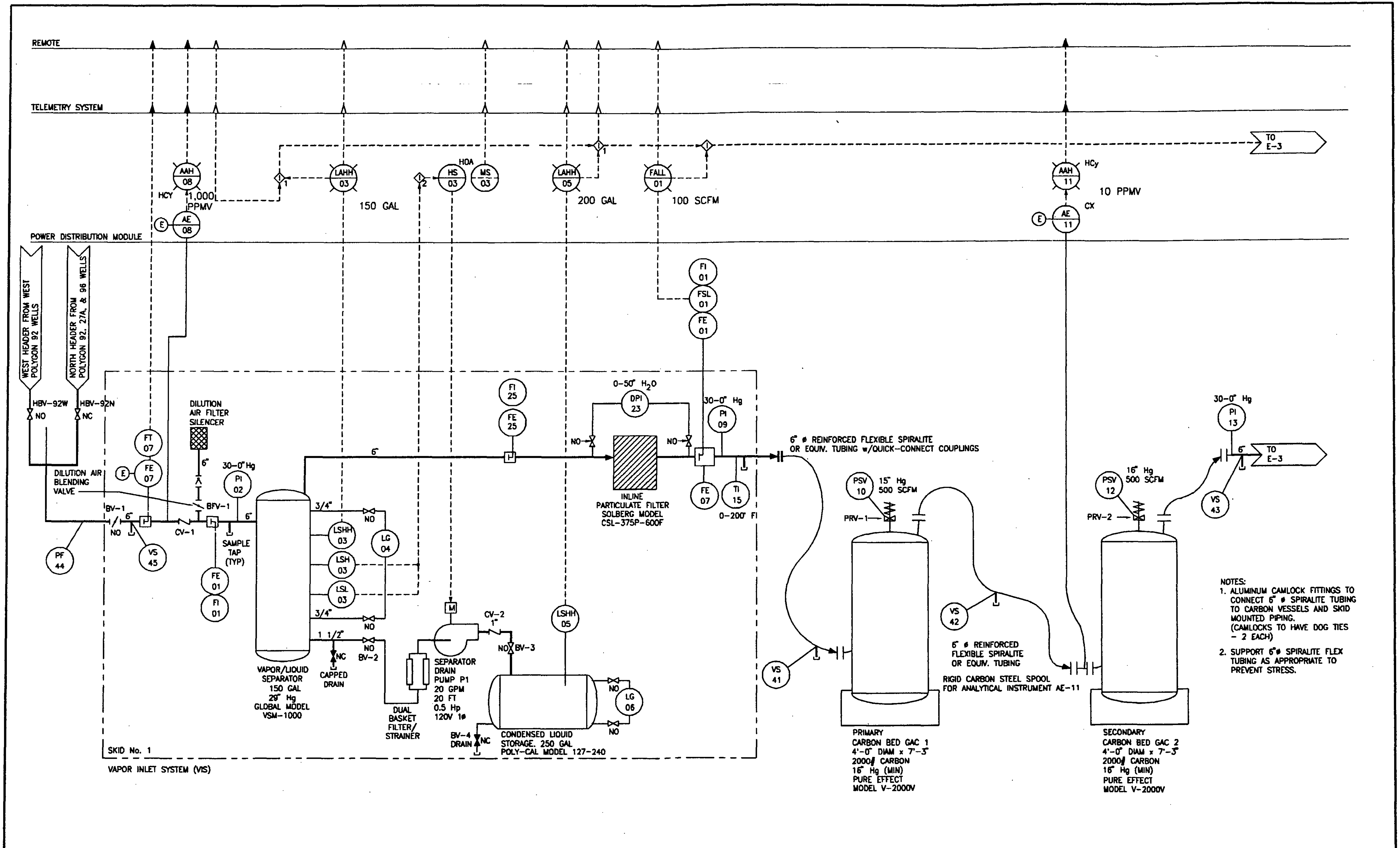

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NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION
1	3-22-93	IB		ELEC. PER MFG. CHANGE
2	10-26-93	IB		CHANGES FOR RECORD DRAWING
3	2-94	SZ		POLYGON 84 DESIGN
4	5-95	KW		POLYGON 96/92/27A DESIGN

M&E METCALF & EDDY

DESIGNED
DRAWN
CHECKED

SCALE: NONE

SAN DIEGO, CA 1994 DATE

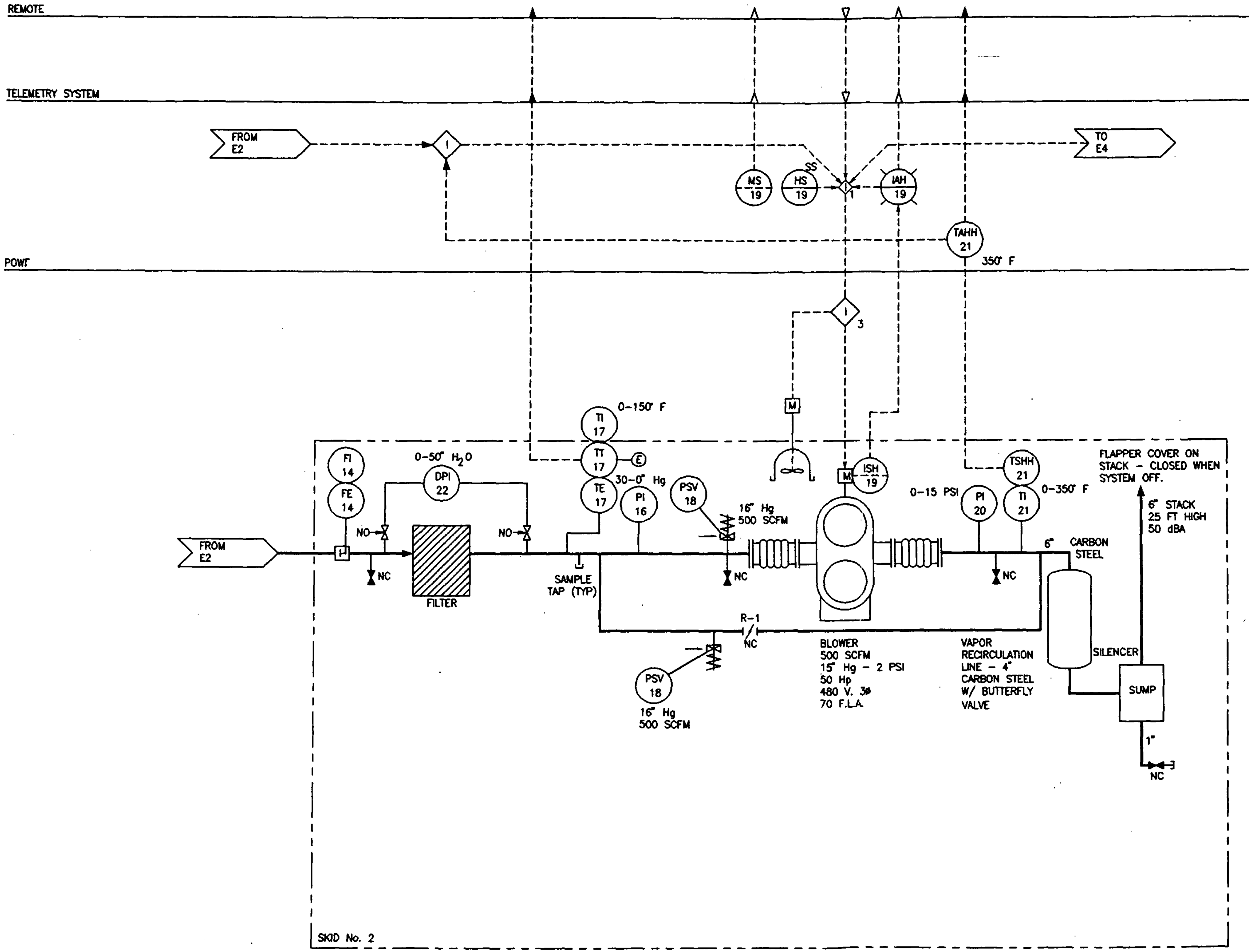
CALIF. R.E. No.

PGA - Goodyear

APPROVED DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN - POLYGON 96/92/27A
PROCESS & INSTRUMENTATION DIAGRAM 1

DRAWING NO: 96-E-2
SHEET: 17
OF 23 SHEETS



INTERLOCK NOTES:

1. LOCK OUT BLOWER WITH MANUAL RESET ON LOW FLOW FROM WELLS, HIGH-HIGH LEVEL IN AIR/WATER SEPARATOR, HIGH-HIGH LEVEL IN CONDENSED LIQUID TANK, BLOWER OVERLOAD, OR BY TELEMETRY
2. START CONDENSATE TRANSFER PUMP ON HIGH LEVEL IN AIR/WATER SEPARATOR, STOP PUMP ON LOW LEVEL IN AIR/WATER SEPARATOR
3. BLOWER CONTROL PANEL EXHAUST FAN TO START AND STOP AT THE SAME TIME AS BLOWER.

NOTE: ALL COMPONENTS SHOWN WITH EXCEPTION OF STACK AND SUMP MOUNTED ON CARBON STEEL BOX-TUBE SKID W/FORKLIFT OR CRANE LIFTING POINTS

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NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION
1	3-22-93	IB		ELEC. PER MFG. CHANGE
2	10-26-93	IB		CHANGES FOR RECORD DRAWING
3	2-94	SZ		POLYGON 84 DESIGN

M&E METCALF & EDDY

DESIGNED
DRAWN
CHECKED

SCALE: NONE

SAN DIEGO, CA — 1994 DATE

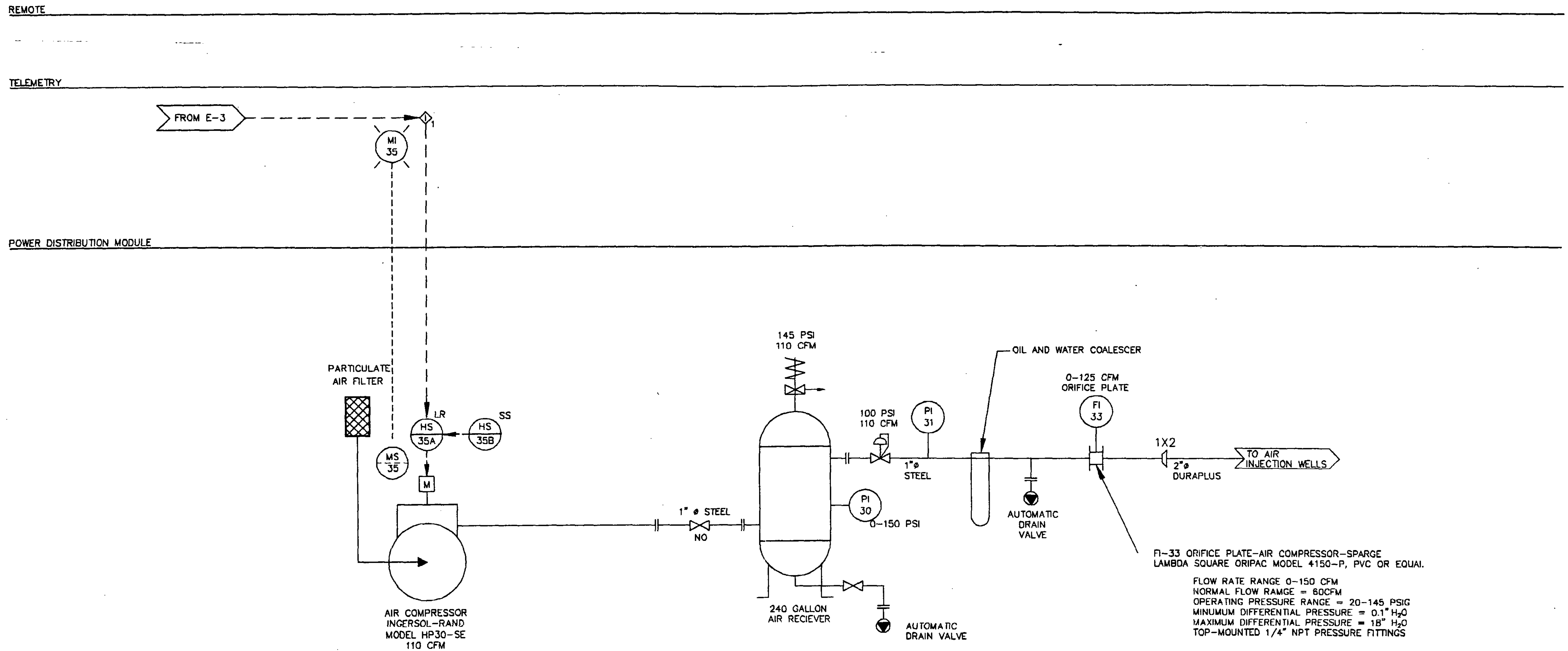
CALIF. R.E. No.

PGA - Goodyear

APPROVED — DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN - POLYGON 96/92/27A
PROCESS & INSTRUMENTATION DIAGRAM 2

DRAWING NO: 96-E-3
SHEET: 18
OF 23 SHEETS



NOTE:
DISCHARGE PRESSURE AND TEMPERATURE DISPLAYED LOCALLY ON COMPRESSOR ELECTRONIC PANEL.

INTERLOCK NOTES:

1. LOCK OUT COMPRESSOR WHEN SVE BLOWER DOES NOT RUN AND /OR WHEN SVE SYSTEM FAILS. COMPRESSOR IS ALLOWED TO RUN ONLY WHEN SVE BLOWER STARTS AND TIME DELAY IS COMPLETED.

L:\AUTOCAD\GOODYEAR\96\96_E_4, 9/21/95

NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION

M&E METCALF & EDDY

DESIGNED
DRAWN
CHECKED

SCALE: NONE

M&E DATE
CALIF. R.E. NO.

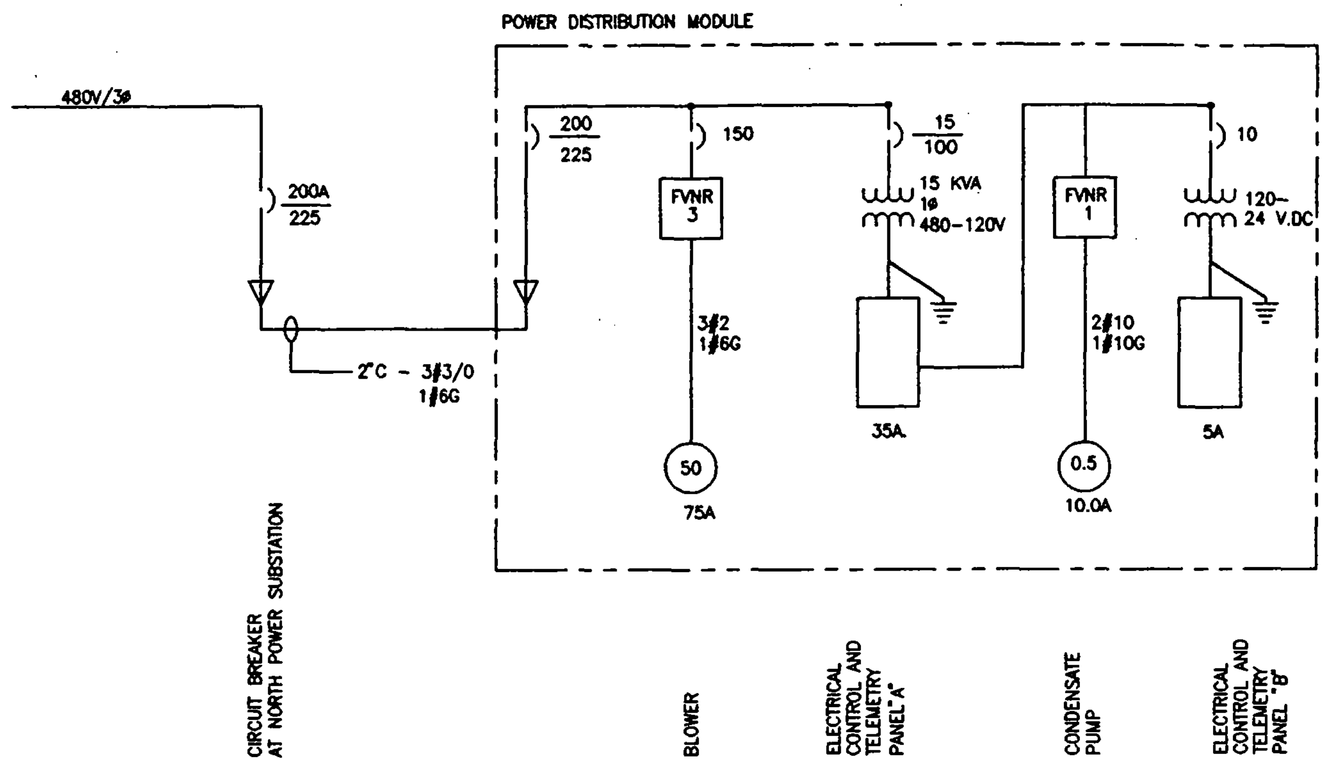
PGA - Goodyear

APPROVED DATE

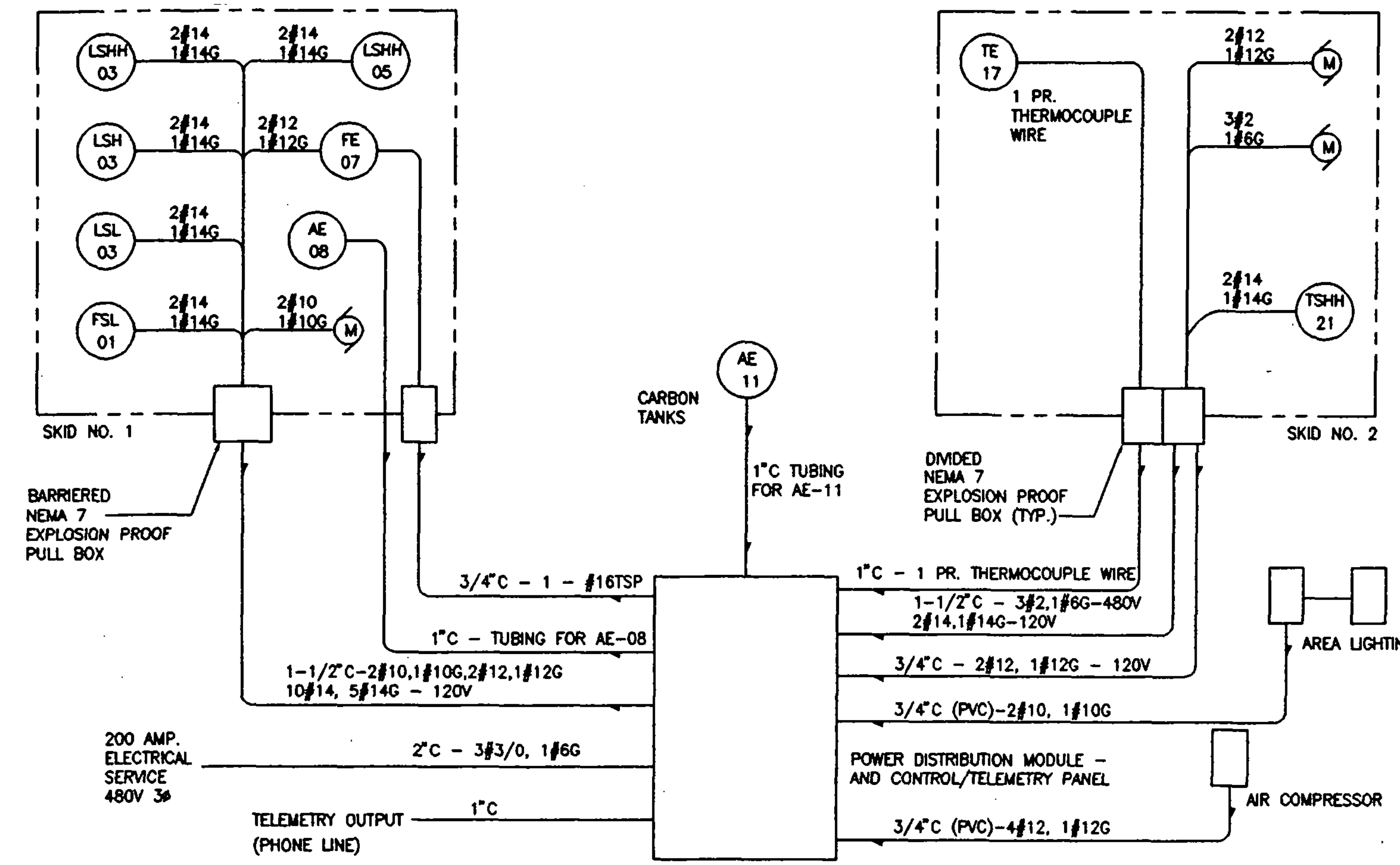
SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN - POLYGON 96/92/27A

PROCESS & INSTRUMENTATION DIAGRAM - 3

DRAWING NO: 96-E-4
SHEET: 19 OF 23 SHEETS



ONE LINE DIAGRAM



ELECTRICAL INTERCONNECTION DIAGRAM

Main: 125

Load	Ckt	Breaker	Breaker	Ckt	Load
BLOWER CONTROL	1	15	15	2	SYSTEM CONTROL
CONDENSATE PUMP CONTROL	3	50	15	4	AE-11
PDM RECEPTACLES	5	20	15	6	PDM LIGHT
AREA LIGHTS	7	20	15	8	TELEMETRY UNIT
BLOWER EXHAUST FAN	9	20	15	10	AE-08
SPARE	11	20	15	12	FI-07
SPARE	13	20	20	14	SPARE
SPARE	15	20	15	16	SPARE
SPARE	17	15	15	18	SPARE
SPARE	19	15	15	20	SPARE

PANEL "A" SCHEDULE

* ALL RECEPTACLE CIRCUITS TO HAVE GROUND FAULT CIRCUIT INTERUPTER TYPE CIRCUIT BREAKER

NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION
1	3-22-93	IB		ELECTRICAL PER MFG. CHANGE
2	10-26-93	IB		CHANGES FOR RECORD DRAWING
3	8-14-95	IB		POLY 96/92/27A AIR SPARGING

M&E METCALF & EDDY

DESIGNED / DRAWN / CHECKED

SCALE: NONE

PGA - Goodyear

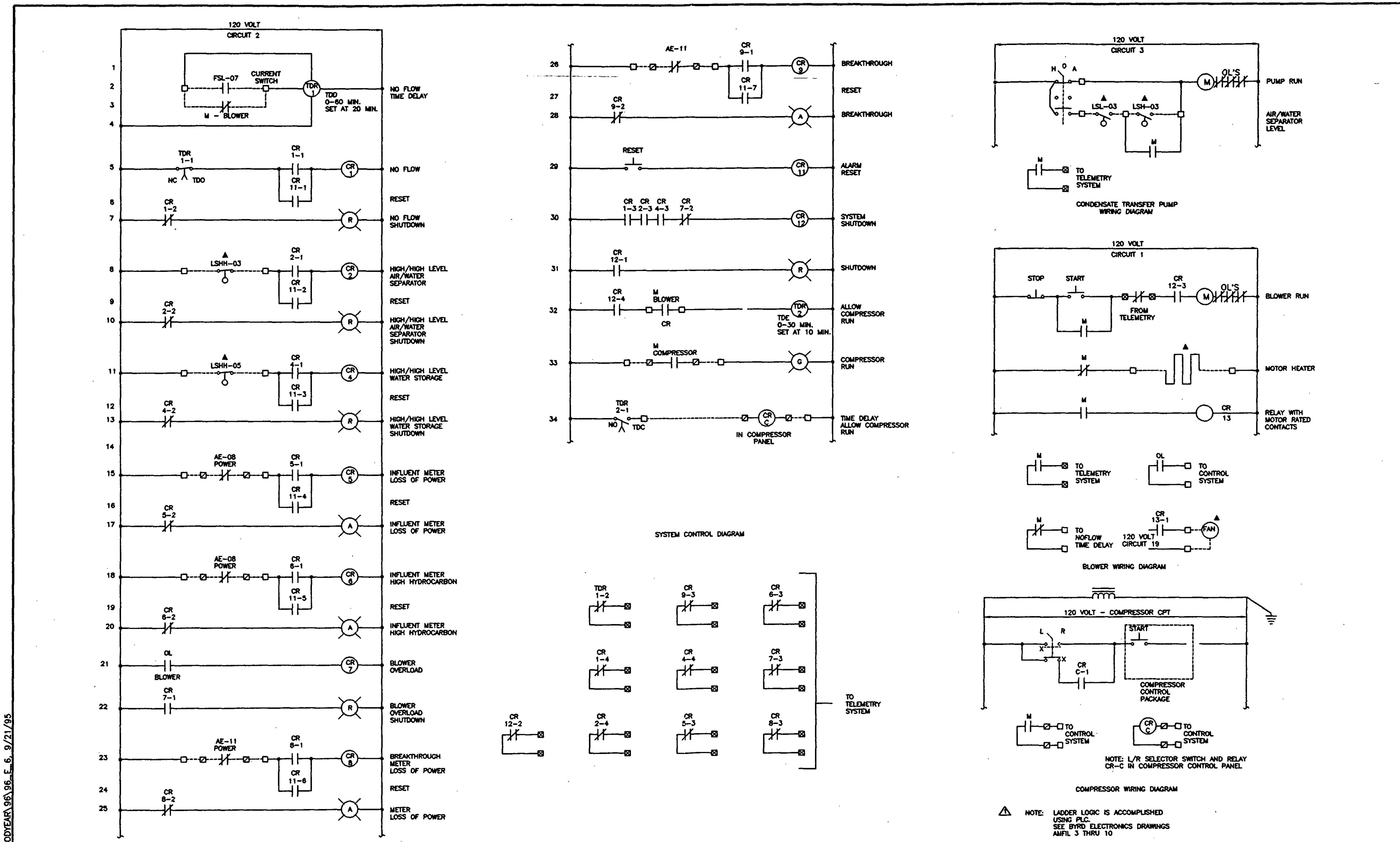
APPROVED DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN - POLYGON 96/92/27A

ELECTRICAL
ONE LINE AND INTERCONNECTION DIAGRAM

DRAWING NO: 96-E-5
SHEET: 20 OF 23 SHEETS

L:\AUTOCAD\GOODYEAR\96\96_E_5, 9/21/95



AUTOCAD\GOODYEAR\96\96_E_6, 9/21/95

NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION
2	8/14/95	IB		POLY 96/92/27A AIR SPARGING
△	10/26/93	IB		RECORD DRAWING

METCALF & EDDY

DESIGNED
DRAWN
CHECKED

SCALE: NONE

CALIF. R.E. No. DATE

PGA - Goodyear

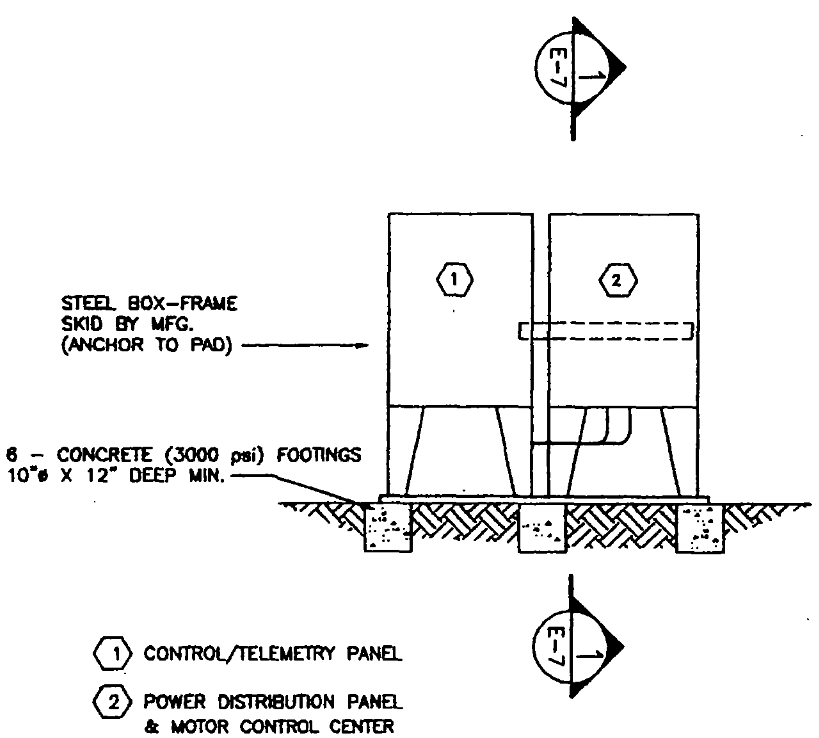
APPROVED DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN - POLYGON 96/92/27A

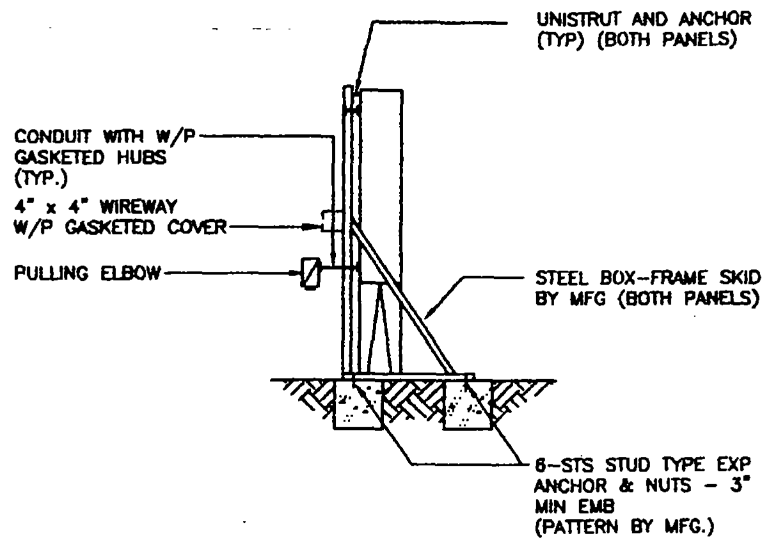
ELECTRICAL CONTROL WIRING DIAGRAM

DRAWING NO: 96-E-6

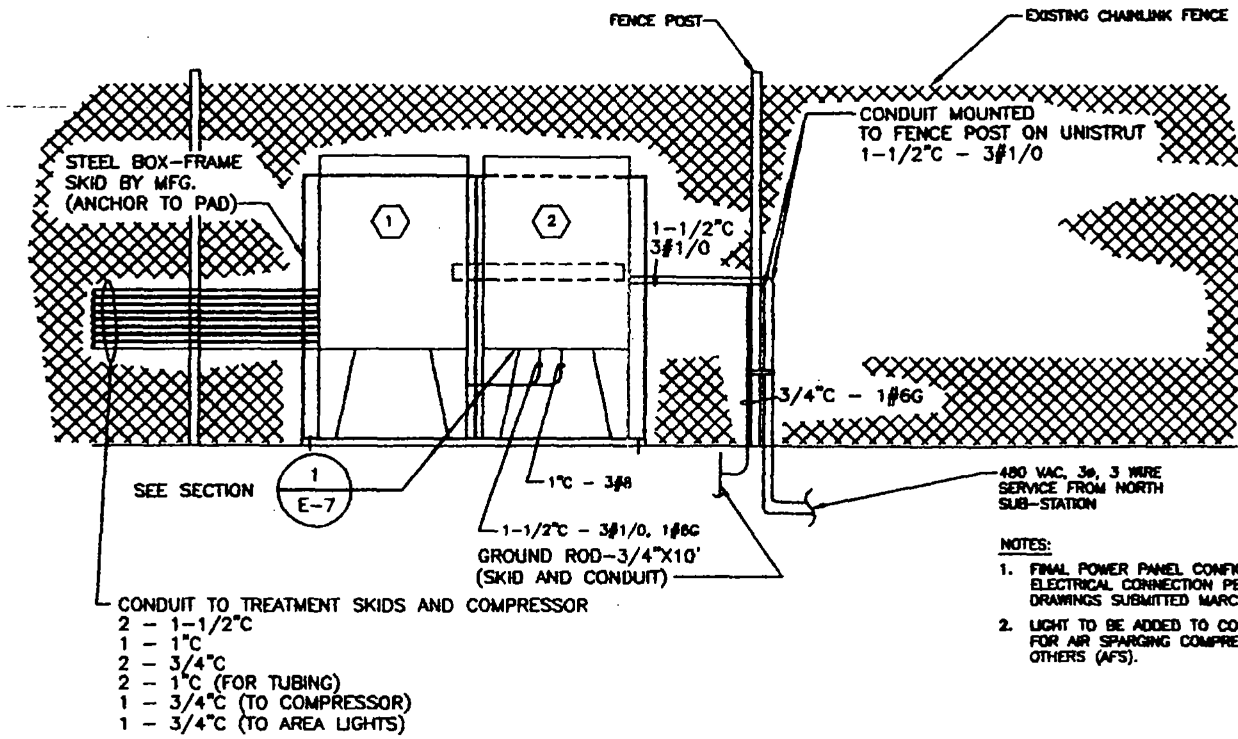
SHEET 21 OF 23 SHEETS



ELEVATION

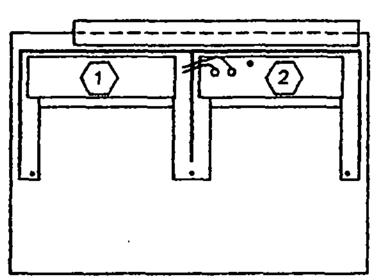


SECTION 1/E-7
SCALE: 1/2"=1'-0"



NOTES:
1. FINAL POWER PANEL CONFIGURATION AND ELECTRICAL CONNECTION PER MFG. DRAWINGS SUBMITTED MARCH-1993.
2. LIGHT TO BE ADDED TO CONTROL PANEL FOR AIR SPARGING COMPRESSOR BY OTHERS (AFS).

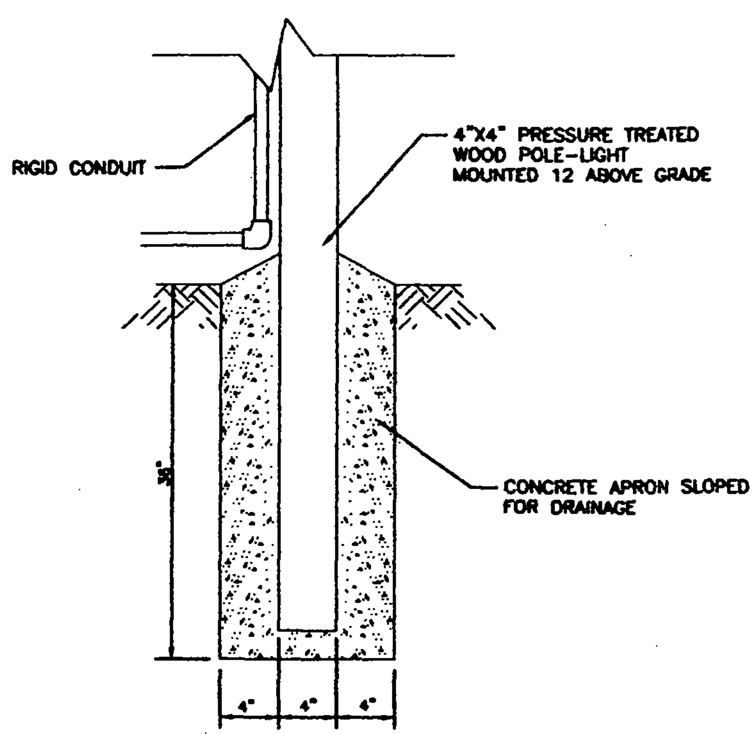
DETAIL
POWER/CONTROL PANEL CONNECTION (21)
SCALE: NONE



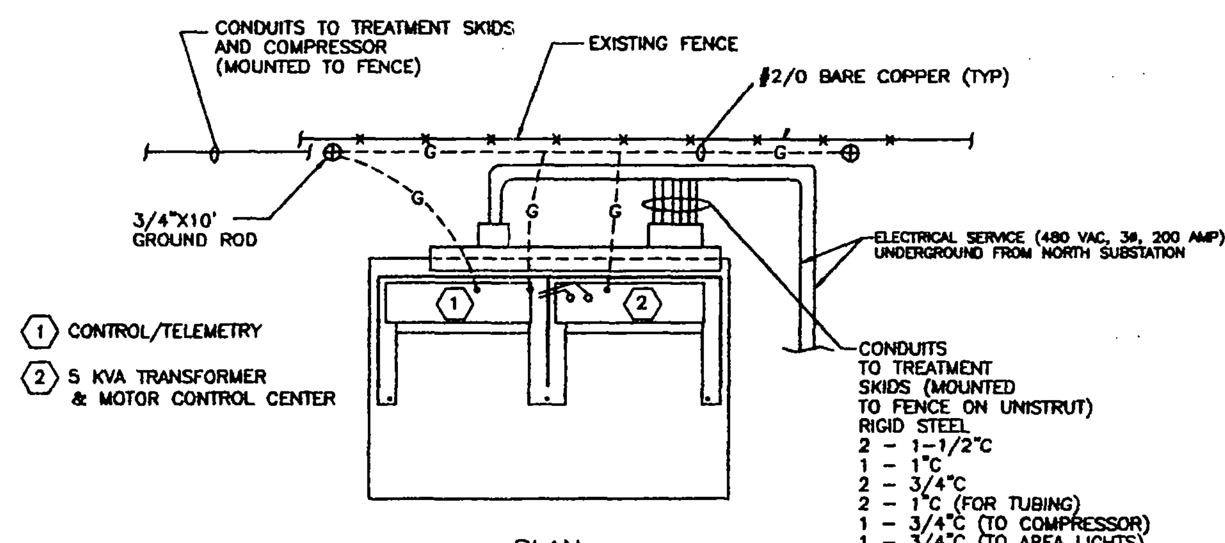
2 NOTES:
1. SEE AMERICAN FILTRATION SYSTEMS DRAWING NO. 8788-05 FOR DETACHED ELECTRICAL CONTROL SYSTEM ARRANGEMENT
2. SEE BYRD ELECTRONICS DRAWING NO. AMFIL 6, 9, AND 10 FOR ELECTRICAL AND CONTROL PANELS LAYOUT.

PLAN

ELECTRICAL CONTROL PANELS
SCALE: NONE



AREA LIGHT FOUNDATION (23)
SCALE: NONE



PLAN

DETAIL
PLANVIEW-POWER/CONTROL PANEL CONNECTION (22)
SCALE: NONE

L:\AUTOCAD\GOODYEAR\96\96_E_7.DWG, 9/21/95

NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION
5	8-95	IB/KW		POLYGON 96/92/27A BID PACKAGE
1	3-22-93	IB		ELEC. PER MFG. CHANGE
2	10-26-93	IB		CHANGES FOR RECORD DRAWING
3	2-94	SZ		POLYGON 84 DESIGN
4	5-95	KW		POLYGON 96/92/27A DESIGN

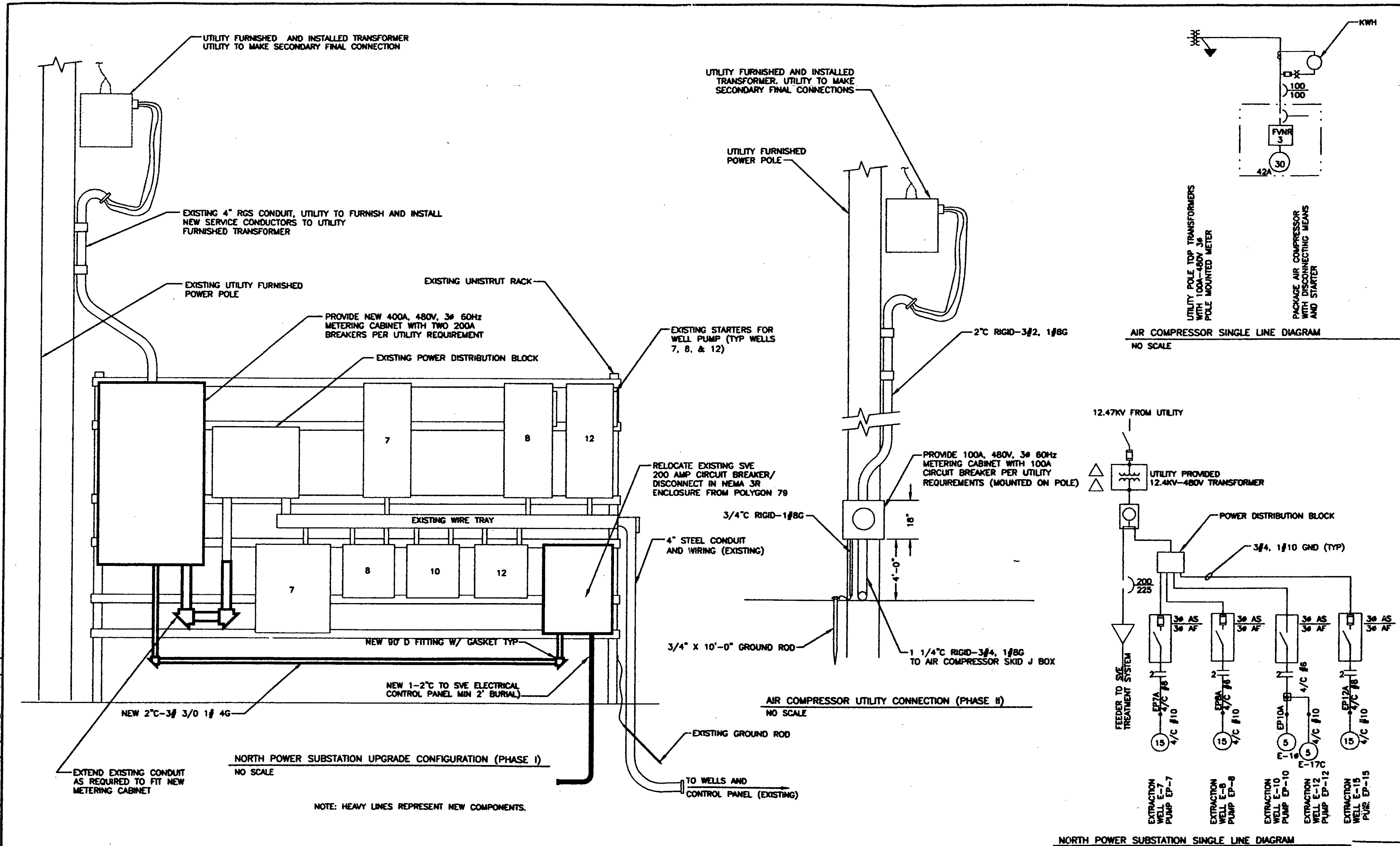
M&E METCALF & EDDY

DESIGNED ______ DRAWN ______ CHECKED ______
SCALE: NONE
M&E SAN DIEGO, CA 1994 DATE
CALIF. R.E. No. ______

PGA - Goodyear
APPROVED ______ DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN - POLYGON 96/92/27A
ELECTRICAL CONTROL PANELS

DRAWING NO: 96-E-7
SHEET 22 OF 23 SHEETS



NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION

M&E METCALF & EDDY

DESIGNED ______
DRAWN GPB
CHECKED ______
SCALE:
MGR ______ DATE
CALIF. R.E. No. ______

PGA - Goodyear

APPROVED ______ DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN - POLYGON 96/92/27A

ELECTRICAL UTILITY SERVICE CONNECTIONS

DRAWING NO: 96-E-8
SHEET: 23
OF 23 SHEETS

APPENDIX B

AMERICAN FILTRATION SYSTEMS, INC.

SVE OPERATION AND MAINTENANCE MANUAL

SECTION 5

ELECTRICAL CONTROL SYSTEM (ECS)
POWER DISTRIBUTION MODULE (PDM)

AFS DRAWING NO. 8788-06	INTERCONNECTION DIAGRAM
AFS DRAWING NO. 8788-05	GENERAL ARRANGEMENT

TABBED DIVIDERS

1.	TELEMETRY & CONTROL SYSTEM	INTRO & SYSTEM DESCRIPTION
2.	TELEMETRY & CONTROL SYSTEM	REMOTE SITES
3.	TELEMETRY & CONTROL SYSTEM	APPENDIX A - GLOSSARY
4.	TELEMETRY & CONTROL SYSTEM	APPENDIX B - PROGRAM LISTINGS
5.	BYRD ELEC DRWG NO. AMFIL7	SYSTEM BLOCK DIAGRAM
6.	BYRD ELEC DRWG NO. AMFIL8	CONTROL & INDICATOR DIAGRAM
7.	BYRD ELEC DRWG NO. AMFIL6	TELEMETRY ENCLOSURE OUTLINE
8.	BYRD ELEC DRWG NO. AMFIL3-5	ENCLOSURE WIRING SCHEMATICS
9.	BYRD ELEC DRWG NO. AMFIL9	ELECTRICAL ENCLOSURE OUTLINE
10.	BYRD ELEC DRWG NO. AMFIL10	PDM OUTLINE & WIRING DIAGRAM
11.	INSTRUCTION MANUAL	H-NU CONTINUOUS GAS MONITOR
12.	USER MANUAL (SEE NOTE)	TELESAFE 6000 **RACO CHATTERBOX CB-4**

NOTE: DUE TO THE AMOUNT OF MATERIAL IN THE TELESAFE AND RACO USER MANUALS, DISTRIBUTION IS LIMITED TO FIELD PERSONNEL AND M&E STAFF ONLY.

APPENDIX C

VAPOR EXTRACTION AND MONITORING WELL

CONSTRUCTION DRAWINGS AND

ORIFICE PLATE FLOW ELEMENT CALCULATION SHEETS

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTION Description Order: Color, Soil Type, Letter Symbol, Density, Moisture, Modifiers
COARSE GRAINED SOILS More Than 50% Of Material Is *LARGER* Than No. 200 Sieve	GRAVEL AND GRAVELLY SOILS More Than 50% Of Coarse Fraction *RETAINED* On No.4 Sieve	Clean Gravels (Little Or No Fines)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.
		Gravels With Fines (Appreciable Amount of Fines)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES.
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES.
	SAND AND SANDY SOILS More Than 50% Of Coarse Fraction *PASSING* No.4 Sieve	Clean Sand (Little or No Fines)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
		Sands with Fines (Appreciable Amount of Fines)		SM	SILTY SANDS, SAND-SILT MIXTURES.
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES.
FINE GRAINED SOILS More Than 50% Of Material Is *SMALLER* Than No. 200 Sieve	SILT AND CLAYS Liquid Limit *LESS* Than 50%			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.
	SILT AND CLAYS Liquid Limit *GREATER* Than 50%			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS.
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS.

BORING VEW-96-1

Phoenix-Goodyear Airport

Metcalf & Eddy

CLIENT: Goodyear Tire and Rubber — **JOB NUMBER:** 017761

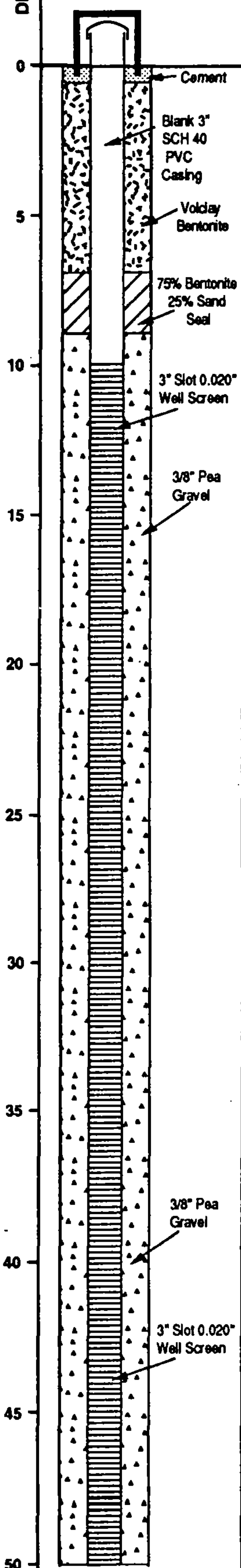
DRILLING METHOD: 6.25" Hollow Stem Auger; CME 75HT

GEOLOGIST: M. Joe Weidmann

CONTRACTOR: Heber Mining & Exploration — **START DATE:** 10/10/95 — **TIME:** 1130

DRILLER: Randy Wilder — **FINISH DATE:** 10/10/95 — **TIME:** 1325

WELL CONSTRUCTION



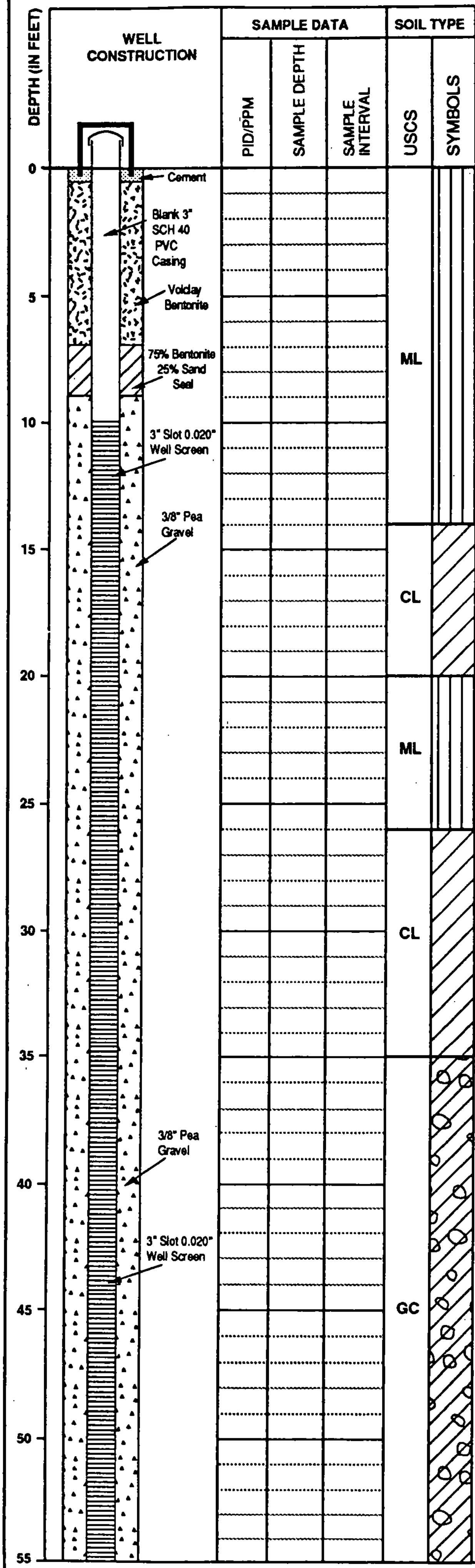
DEPTH (IN FEET)	PID/PPM	SAMPLE DEPTH	SAMPLE INTERVAL	USCS	DESCRIPTION
0				ML	0-5' Light brown, very fine sandy SILT (ML), dry.
5				ML	5-10' As above.
10				ML / CL	10-15' As above, becomes brown, CLAY (CL) at ~12', little silt, slightly damp, hard caliche ~11-12'.
15				CL	15-20' As above, silty CLAY (CL) from 17-20', hard caliche at ~17', damp.
20				CL	20-25' As above, becomes brown, CLAY (CL) at ~22', damp.
25				CL	25-30' As above.
30				CL / SW	30-35' As above, becomes fine to medium SAND (SW), well-graded, little coarse SAND (SW), trace gravel at ~31', slightly damp to damp.
35				SW / GW	35-40' As above, GRAVEL (GW) and cobbles begin at ~36', some well-graded sand, minor silt and clay layers, damp.
40				GC	40-45' Clayey GRAVELS (GC) and cobbles, minor sand, damp.
45				GC	45-50' As above, moist.
50					Total depth of 50' below ground surface. No groundwater encountered. No odors or PID readings encountered during drilling.
55					

BORING VEW-96-2

Phoenix-Goodyear Airport

Metcalf & Eddy

CLIENT: Goodyear Tire and Rubber **JOB NUMBER:** 017761
DRILLING METHOD: 6.25" Hollow Stem Auger; CME 75HT
GEOLOGIST: M. Joe Weidmann
CONTRACTOR: Heber Mining & Exploration **START DATE:** 10/3/95 **TIME:** 0805
DRILLER: Randy Wilder **FINISH DATE:** 10/3/95 **TIME:** 1000



0-5' Light brown, fine sandy SILT (ML), trace to little medium sand, dry.

5-10' Same as above.

10-15' Same as above, caliche at ~12', becomes a brown, silty CLAY (CL), at ~14', slightly damp.

15-20' Brown, CLAY (CL), becomes a silty CLAY(CL), at ~19', damp.

20-25' Brown, clayey SILT (ML), becomes a SILT (ML), with little clay and little fine to medium sand, trace coarse sand at 24', caliche at ~24', slightly damp.

25-30' As above, becomes a silty CLAY (CL), little to fine coarse sand at ~26', damp.

30-35' Brown, CLAY (CL), little silt, trace sand, gravels at~32', little sand at ~34', damp.

35-40' CLAYEY GRAVEL to GRAVELLY CLAY (GC), minor sand, damp.

40-45' Same as above.

45-50' Same as above.

50-55' Same as above, slightly moist.

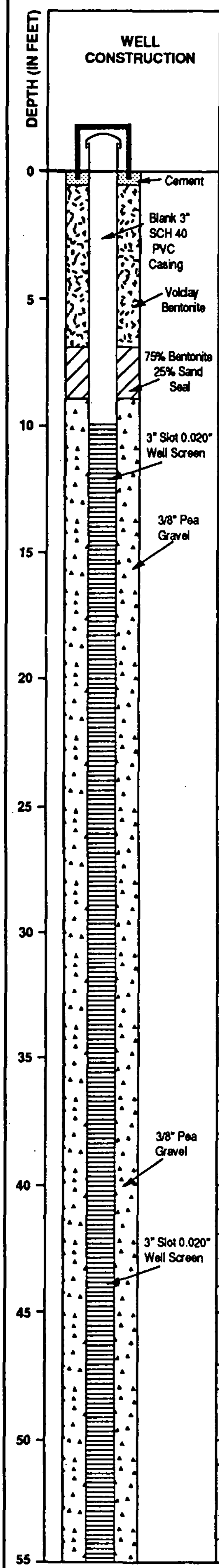
Total depth of 55' below ground surface.
No groundwater encountered.
No odors or PID readings encountered during drilling.

BORING VEW-96-3

Phoenix-Goodyear Airport

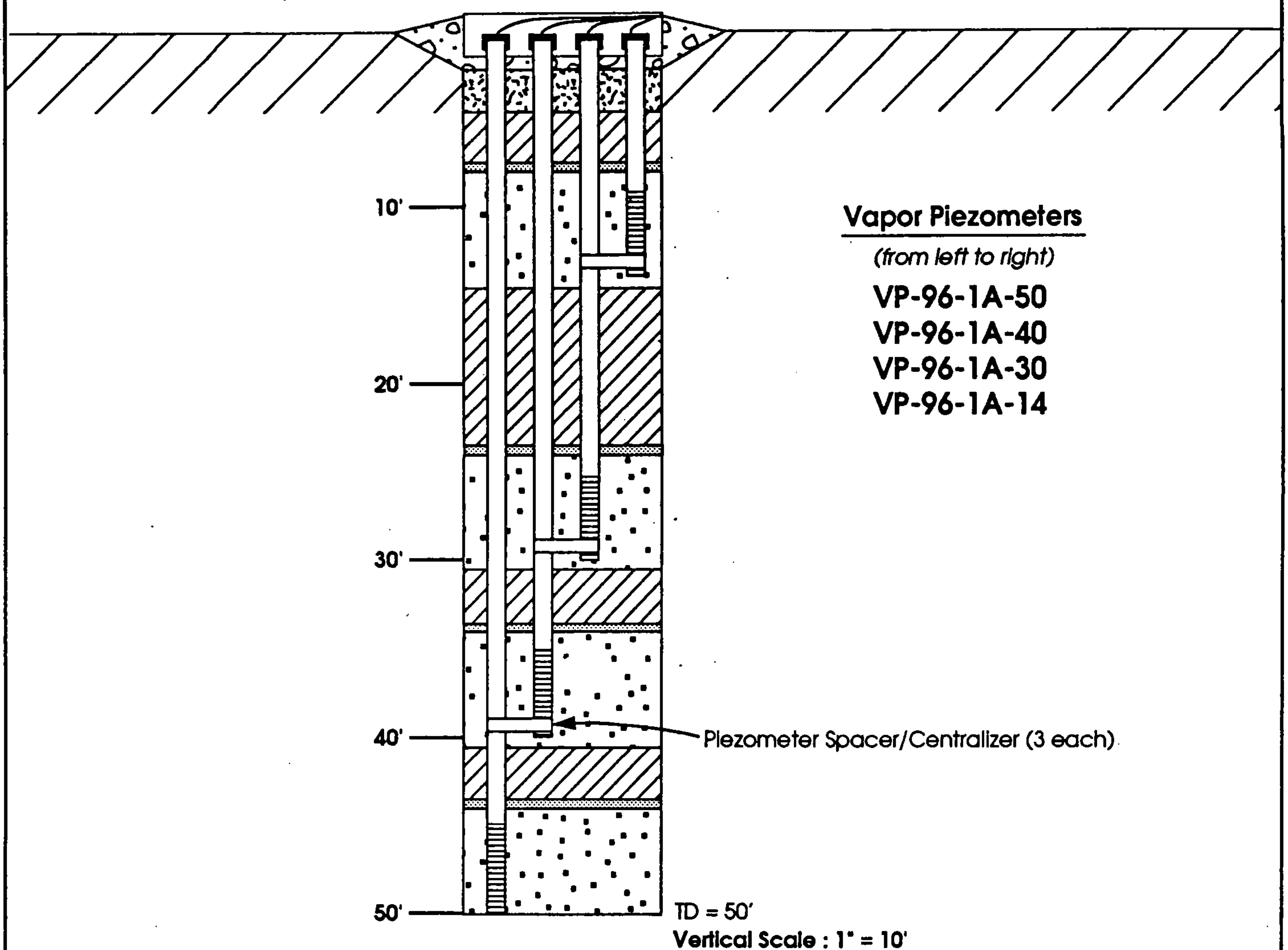
CLIENT: Goodyear Tire and Rubber
JOB NUMBER: 017761
DRILLING METHOD: 6.25" Hollow Stem Auger; CME 75HT
GEOLOGIST: M. Joe Weidmann
CONTRACTOR: Heber Mining & Exploration
START DATE: 10/2/95 **TIME:** 1050
DRILLER: Randy Wilder
FINISH DATE: 10/3/95 **TIME:** 0805

Metcalf & Eddy



SAMPLE DATA: PID/PPM	SAMPLE DEPTH	SAMPLE INTERVAL	SOIL TYPE: USCS	DESCRIPTION
			ML	0-5' Light brown, SILT (ML), trace to little sand, dry.
			ML	5-9' Light brown, SILT (ML), dry.
			ML / SW	9-15' Light brown, clayey SILT (ML), becomes silty fine to medium SAND (SW), at ~13', little to coarse sand, trace gravel, slightly damp.
			SW / CL	15-20' Light brown, silty fine to medium SAND (SW), becomes brown, clay at 16', damp.
			CL	20-25' Brown, CLAY (CL), little silt, trace sand, caliche from 21-23', damp.
			CL	25-30' Brown, CLAY (CL), little silt, trace sand, damp.
			CL	30-35' Brown, CLAY (CL), little silt, trace sand, damp.
			CL / ML	35-40' Brown, CLAY (CL), little silt, trace sand, gravels and cobbles from 36-38', becomes clayey SILT (ML), at ~38', some fine to coarse sand, slightly damp.
			ML / GC	40-45' Brown, clayey SILT (ML), some fine sand, becomes CLAYEY GRAVEL to GRAVELLY CLAY (GC), at ~42', minor sand, trace silt, damp.
			GC	45-50' Brown, CLAYEY GRAVEL to GRAVELLY CLAY (GC), little sand, damp.
			GC	50-55' Brown, as above, slightly moist.

Total depth of 55' below ground surface.
No groundwater encountered.
No odors or PID readings encountered during drilling.



EXPLANATION

Redi-Mix Cement

Grout-
95% Portland Cement and
5% Volclay Bentonite

Bentonite Seal-
Dry crumbles to seal water table

Bentonite Seal-
75% Bentonite Chips and
25% 8-12 Sand

Sand Seal-
Colorado #30 Silica

Gravel Pack-
Colorado 8-12 Silica

Note: All Piezometers constructed of 1/2" ID SCH 40 PVC with 5 ft. length of 0.02" machine slot screen

Note 2: All Piezometer names reference bottom of screened interval

PROJECT: Phoenix-Goodyear Airport

TITLE: Well Construction Log VP-96-1A

CLIENT: Goodyear Tire & Rubber

LOCATION: VP-96-1A

JOB NUMBER: 017761

Metcalf & Eddy

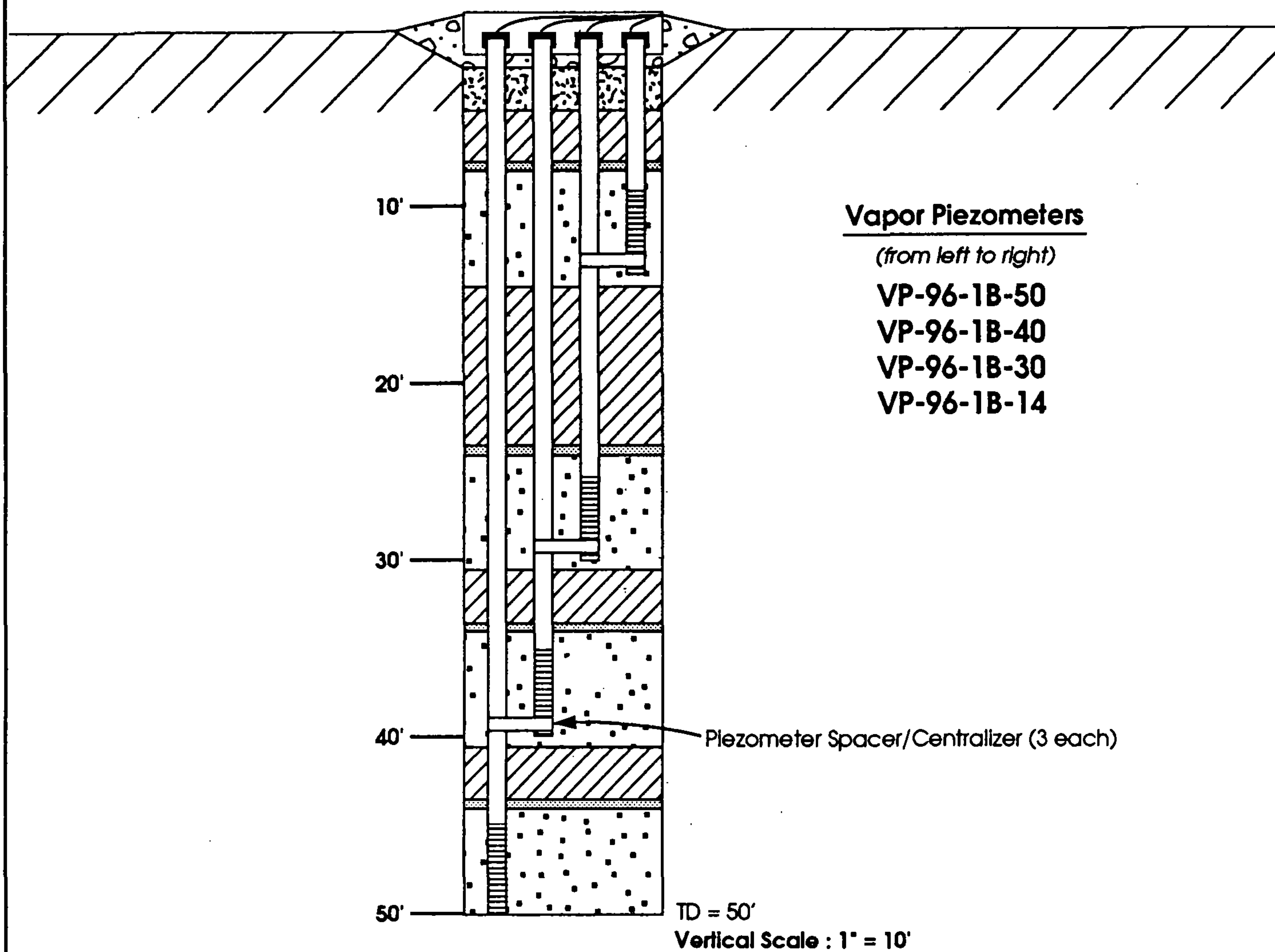
BORING VP-96-1A

Phoenix-Goodyear Airport

Metcalf & Eddy

CLIENT: Goodyear Tire and Rubber **JOB NUMBER:** 017761
DRILLING METHOD: 8.25" Hollow Stem Auger; CME 75HT
GEOLOGIST: M. Joe Weidmann
CONTRACTOR: Heber Mining & Exploration **START DATE:** 10/11/95 **TIME:** 0905
DRILLER: Randy Wilder **FINISH DATE:** 10/11/95 **TIME:** 1455

DEPTH (IN FEET)	IN. RECOVERED/ IN. DRIVEN	BLOWS PER 6 INCHES	PID/PPM	SAMPLE DEPTH	SAMPLE TYPE	TIME	USCS	Description
0							ML	0-5' Reddish brown, very fine sandy SILT (ML), dry.
5							ML	5-10' As above.
10							ML	10-15' As above, becomes CLAY (CL) at ~13', hard caliche at 13', slightly damp.
15							CL	15-20' Brown, CLAY (CL), little silt, hard caliche from 17-18', slightly damp.
20							CL	20-25' Brown, silty CLAY (CL), sand, gravel and cobbles from 22-23', some weathered granite, becomes CLAY (CL), little silt at 23', slightly damp.
25	18/18	5/9/10	0	25	SS	0945	CL	25-26.5' Brown, silty CLAY (CL),trace to fine sand, damp.
							CL / GW	26.5-30' As above, becomes sand and GRAVEL (GW) at ~28'.
30	18/18	22/28/30	0	30	SS	1000	SW	30-31.5' Brown, silty fine to medium SAND (SW), intervals of fine to coarse, well-graded sand, trace gravels, intervals of clayey silt to silty clay.
							SW	31.5-35' Well-graded, fine to coarse SAND (SW), intervals of silt and clay, gravels at 31' and 33'.
35	18/14	25/30/35	0	35	SS	1020	GC	35-36.5' Coarse sand and GRAVEL (GC), little fine to medium sand, interbedded silt and clay, damp.
							GC	36.5-40' As above, cobbles begin at ~37'.
40							GC	40-45' GRAVELS and cobbles (GC), minor silt, clay and sand, damp.
45							GC / GW	45-50' As above, sand and GRAVEL (GW) 48-50', moist.
50								Total depth 50' below ground surface. No groundwater encountered. No odors or PID reading encountered.
55								



EXPLANATION

Redi-Mix Cement

Grout-
95% Portland Cement and
5% Volclay Bentonite

Bentonite Seal-
Dry crumbles to seal water table

Bentonite Seal-
75% Bentonite Chips and
25% 8-12 Sand

Sand Seal-
Colorado #30 Silica

Gravel Pack-
Colorado 8-12 Silica

Note: All Piezometers constructed of 1/2" ID SCH 40 PVC with 5 ft. length of 0.02" machine slot screen

Note 2: All Piezometer names reference bottom of screened interval

PROJECT: Phoenix-Goodyear Airport
TITLE: Well Construction Log VP-96-1B
CLIENT: Goodyear Tire & Rubber
LOCATION: VP-96-1B
JOB NUMBER: 017761

M&E Metcalf & Eddy

BORING VP-96-1B

Phoenix-Goodyear Airport

M&E Metcalf & Eddy

CLIENT: Goodyear Tire and Rubber **JOB NUMBER:** 017761

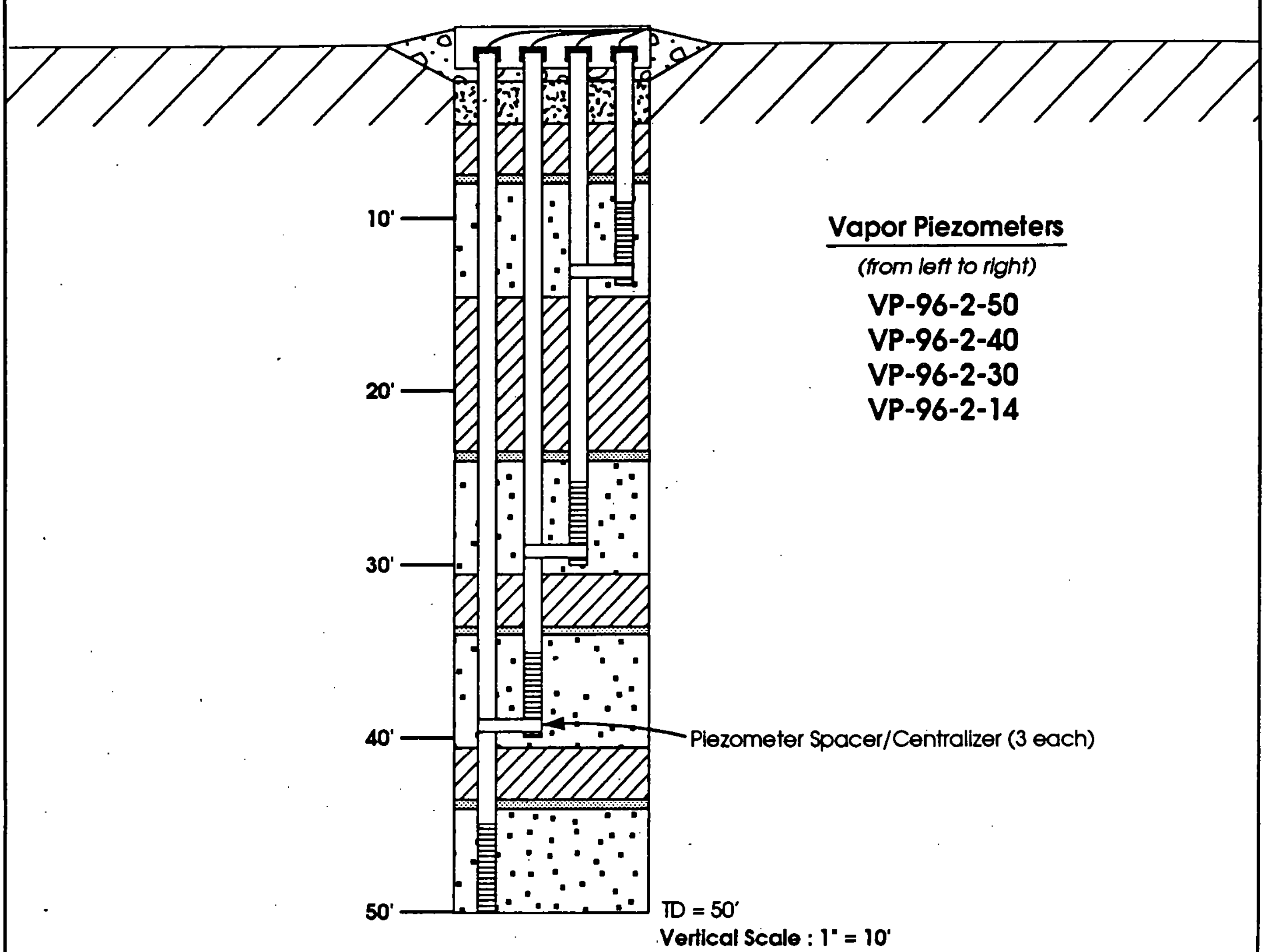
DRILLING METHOD: 8.25" Hollow Stem Auger; CME 75HT

GEOLOGIST: M. Joe Weidmann

CONTRACTOR: Heber Mining & Exploration **START DATE:** 10/12/95 **TIME:** 0800

DRILLER: Randy Wilder **FINISH DATE:** 10/12/95 **TIME:** 1435

DEPTH (IN FEET)	IN. RECOVERED/ IN. DRIVEN	BLOWS PER 6 INCHES	PID/PPM	SAMPLE DEPTH	SAMPLE TYPE	TIME	USCS	DESCRIPTION
0							ML	0-5' Reddish brown, very fine sandy SILT (ML), trace gravel and cobbles, dry.
5							ML	5-10' Reddish brown, very fine sandy SILT (ML), hard caliche from 7-10', dry.
10							ML	10-15' Reddish brown, very fine sandy SILT (ML), trace gravel, hard caliche ~12-13', *slightly damp*.
15							ML / CL	15-20' As above, becomes brown, silty CLAY (CL) at ~16', hard caliche from ~17-19', trace gravels and cobbles.
20							CL	20-25' Clayey silt to silty CLAY (CL), hard caliche ~21-23', trace to little gravel and cobbles, slightly damp.
25	18/18	6/6/9	0	25	SS	0855	CL	25-26.5' Brown, silty CLAY (CL), slightly damp. 26.5-30' Brown, silty CLAY (CL), damp.
30	18/16	12/14/20	0	30	SS	0910	CL	30-31.5' Brown, silty CLAY (CL), damp. 31.5-35' Brown, silty CLAY (CL), damp.
35	18/7	8/12/14	0	35	SS	1205	SW	35-36.5' Light brown, medium to very coarse SAND (SW), little fine to sand, trace silt, trace to little gravel, slightly damp. 36.5-40' Medium to very coarse SAND (SW), well-graded, gravel at ~31' and 33', minor intervals of silt and clay.
40							GC	40-45' Clayey GRAVEL (GC) and cobbles, minor sand, damp.
45							GC / GW	45-50' Clayey GRAVEL (GC) and cobbles, minor sand, sand and GRAVEL (GW) from 48-50', slightly moist.
50								Total depth 50' below ground surface. No groundwater encountered. No odors or PID reading encountered.
55								



EXPLANATION

Redi-Mix Cement

Grout-
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Bentonite Seal-
Dry crumbles to seal water table

Bentonite Seal-
75% Bentonite Chips and
25% 8-12 Sand

Sand Seal-
Colorado #30 Silica

Gravel Pack-
Colorado 8-12 Silica

Note: All Piezometers constructed of 1/2" ID SCH 40 PVC with 5 ft. length of 0.02" machine slot screen

Note 2: All Piezometer names reference bottom of screened interval

PROJECT: Phoenix-Goodyear Airport

TITLE: Well Construction Log VP-96-2

CLIENT: Goodyear Tire & Rubber

LOCATION: VP-96-2

JOB NUMBER: 017761

M&E
Metcalf & Eddy

BORING VP-96-2

Phoenix-Goodyear Airport

CLIENT: Goodyear Tire and Rubber — **JOB NUMBER:** 017761

DRILLING METHOD: 8.25" Hollow Stem Auger; CME 75HT

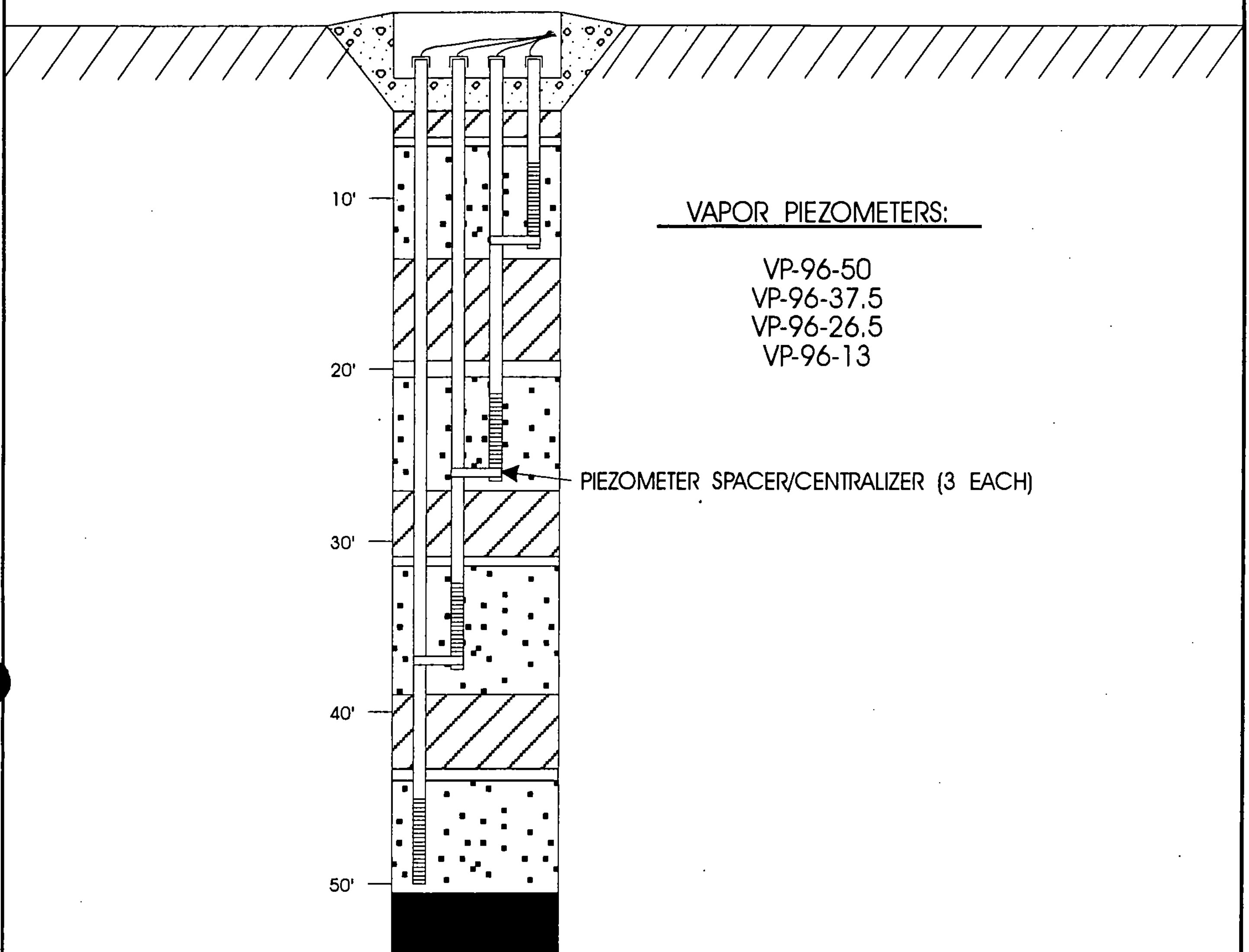
GEOLOGIST: M. Joe Weidmann

CONTRACTOR: Heber Mining & Exploration — **START DATE:** 10/9/95 — **TIME:** 0920

DRILLER: Randy Wilder — **FINISH DATE:** 10/9/95 — **TIME:** 1120

Metcalf & Eddy

DEPTH (IN FEET)	IN. RECOVERED/ IN. DRIVEN	BLOWS PER 6 INCHES	PID/PPM	SAMPLE DEPTH	SAMPLE TYPE	TIME	USCS	DESCRIPTION
0							ML	0-5' Brown, fine sandy SILT.
5							ML	5-10' Brown, fine sandy SILT (ML), becomes brown silty CLAY (CL), at ~7', hard caliche from ~7-8', slightly damp.
10							CL	10-15' Brown, CLAY (CL), trace to little silt, slightly damp, hard caliche at ~12'.
15							CL	15-20' Brown, CLAY (CL), trace silt, hard caliche from 17-18', damp.
20							CL	20-25' Brown, CLAY (CL), trace silt, slightly damp to damp.
25							CL	25-30' Brown, CLAY (CL), little silt, damp.
30	18/18	9/12/11	0	30	SS	1005	CL	30-31.5' Brown, silty CLAY (CL), damp, trace localized organic material.
							ML	31.5-35' Brown, SILTY CLAY to CLAYEY SILT (ML), slightly damp.
35	18/14	10/23/21	0	35	SS	1026	ML	35-36.5' Brown, clayey SILT (ML), little fine to medium sand, grading at 35.5' to a silty, fine to medium SAND (SW), trace coarse sand, grading at ~36' to a medium to very coarse, well-graded SAND (SW), trace to little fine gravel, slightly damp.
							SW	36.5-40' Brown, well-graded, SAND (SW), gravel at ~37'.
40	18/13	13/18/25	0	40	SS	1040	CL / GW	40-41.5' Brown, silty CLAY (CL), some pockets of gravel, some coarse to very coarse sand, trace fine to medium SAND (SW), grades at 40.5' to gravel (GW), some coarse to very coarse sand, trace fine to medium sand, some pockets of silty clay, damp.
							GC	41.5-45' CLAYEY GRAVEL to GRAVELLY CLAY (GC), minor sand and silt, damp.
45	18/11	15/17/24	0	45	SS	1055	GW	45-46.5' Coarse sand to coarse gravel (GW), little fine to medium sand, trace silt and clay, some pockets of silty clay,damp.
							GC	46.5-50' CLAYEY GRAVEL to GRAVELLY CLAY (GC), minor sand and silt, moist.
50								Total depth 50' below ground surface. No groundwater encountered. *No odors or PID reading encountered.*
55								



VERTICAL SCALE: 1" = 10'

EXPLANATION

BENTONITE SEAL - DRY CRUMBLES TO SEAL WATER TABLE

BENTONITE SEAL - 75% 8-12 BENTONITE CHIPS AND 25% 8-12 SAND

SAND SEAL - COLORADO #30 SILICA

GRAVEL PACK - COLORADO 8-12 SILICA

* ALL PIEZOMETERS CONSTRUCTED OF 1/2" ID SCH 40 PVC WITH 5 FT. LENGTH OF 0.02" MACHINE SLOT SCREEN

PROJECT: Phoenix - Goodyear Airport

TITLE: Well Construction Log VP-96

CLIENT: Goodyear Tire & Rubber

LOCATION: VB-96

JOB NUMBER: 012014-0001

Metcalf & Eddy

VP-96

JOB NUMBER	CLIENT	LOCATION
012014-0001	GOODYEAR TIRE AND RUBBER	VB-96

DRILLING METHOD 8.25" I.D. HOLLOW STEM AUGER

SAMPLING METHOD 2" I.D. X 18" CAL. MODIFIED SPLIT SPOON SAMPLER

CONTRACTOR HEBER MINING AND EXPLORATION - CME 45HT

DRILLER RANDY

ENGINEER WEIDMANN

START DATE: 2/11/93 TIME: 1040

FINISH DATE: 2/11/93 TIME: 1430

DEPTH (FEET)	SAMPLER TYPE	IN. DRIVEN/RECOVERED	SAMPLE NUMBER(DEPTH)	RECOVERED INTERVAL	BLOWS PER 6 INCHES	SAMPLE VAPORS (PID IN PPM)	SOIL GRAPH	DESCRIPTION
0								SURFACE: DIRT
4	SS	18/14	4		2/2/2	11	CL	BROWN, SILTY CLAY, CL, SOFT, MOIST, ORGANIC MATERIAL AT 5' BGS
9	SS	18/14	9		4/4/5	0	ML	BROWN, CLAYEY SILT, ML, STIFF, MOIST, TRACE SAND
14	SS	18/14	14		5/5/16	0	CL	AS ABOVE, GRADING TO SILTY CLAY, CL, VERY STIFF, MOIST
19	SS	18/15	19		8/70/51	31.8	ML / CAL	REDDISH BROWN, SILTY CLAY/CLAYEY SILT, HARD, MOIST, SOME SAND, GRADING AT 20' BGS TO CALICHE, HARD
24	SS	18/15	24		10/10/11	20	SP / CL	LIGHT BROWN, FINE SAND, SP, MEDIUM DENSE, MOIST, GRADING AT 24.5' BGS TO YELLOWISH RED, SILTY CLAY, CL, MOIST
29	SS	18/16	29		13/23/23	33	SM / SW / ML	BROWNISH YELLOW, SILTY SAND, SM, VERY DENSE, MOIST, POORLY GRADED, GRADING AT 30' BGS TO SAND, SW, WELL GRADED, LITTLE CLAY AND GRAVELS, GRADING AT 30.5' BGS, TO DARK BROWN, SANDY SILT, ML
34	SS	18/18	34		20/31/32	24	SP	LIGHT BROWN TO BROWN, FINE TO MEDIUM SAND, SP, VERY DENSE, MOIST, POORLY GRADED

VP-96

PAGE	JOB NUMBER	CLIENT	LOCATION
2 OF 2	012014-0001	GOODYEAR TIRE AND RUBBER	VB-96

DRILLING METHOD 8.25" I.D. HOLLOW STEM AUGER

SAMPLING METHOD 2" X 18" CAL. MODIFIED SPLIT SPOON SAMPLER

CONTRACTOR HEBER MINING AND EXPLORATION - CME 45HT

DRILLER RANDY   ENGINEER WEIDMANN

START DATE: 2/11/93   TIME: 1040

FINISH DATE: 2/11/93   TIME: 1430

DEPTH (FEET)	SAMPLER TYPE	IN. DRIVEN/RECOVERED	SAMPLE NUMBER(DEPTH)	RECOVERED INTERVAL	BLOWS PER 6 INCHES	SAMPLE VAPORS (PID IN PPM)	SOIL GRAPH	DESCRIPTION
35				■			SP	
36							SP	
37							CL	
38							CL	
39	SS	18/15	39	■	45/75/?	24	CL	DARK BROWN, SANDY CLAY, CL, HARD, MOIST, GRADING TO GRAVELLY SAND, SW, WELL GRADED, LARGE COBBLE IN NOSE OF SAMPLER
40							SW	
41							SW	DRILLERS REPORT GRAVELS AT 39.5 FT
42							SW	
43							SW	
44	SS	18/18	44	■	29/50/50	8	SW	DARK BROWN, GRAVELLY SAND, SW, VERY DENSE, MOIST, SOME CLAY, WELL GRADED, BLACK STAINING ON COBBLES AND GRAVELS, NO ODOR
45							SW	
46							SW	
47							SW	
48							GW	
49	SS	12/12	49	■	38/75	1.2	GW	SANDY GRAVEL, GW, VERY DENSE, MOIST, WELL GRADED, LITTLE CLAY, GRADING TO COARSE SAND, SP, POORLY GRADED, SOME GRAVEL, NO STAINING
50							SP	
51							SP	
52							SW	
53							SW	WATER LEVEL AT 53.5' BGS ON 2/11/93
54	SS	18/18	54	■	10/16/21	0	SW	BROWN, MEDIUM SAND, SW, DENSE, WET, WELL GRADED
55							SW	
56								
57								
58								
59								
60								
61								
62								
63								
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65								
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68								
69								
70								

▽ DENOTES MEASURED WATER TABLE DEPTH

BORING VEW-92-1

Phoenix-Goodyear Airport

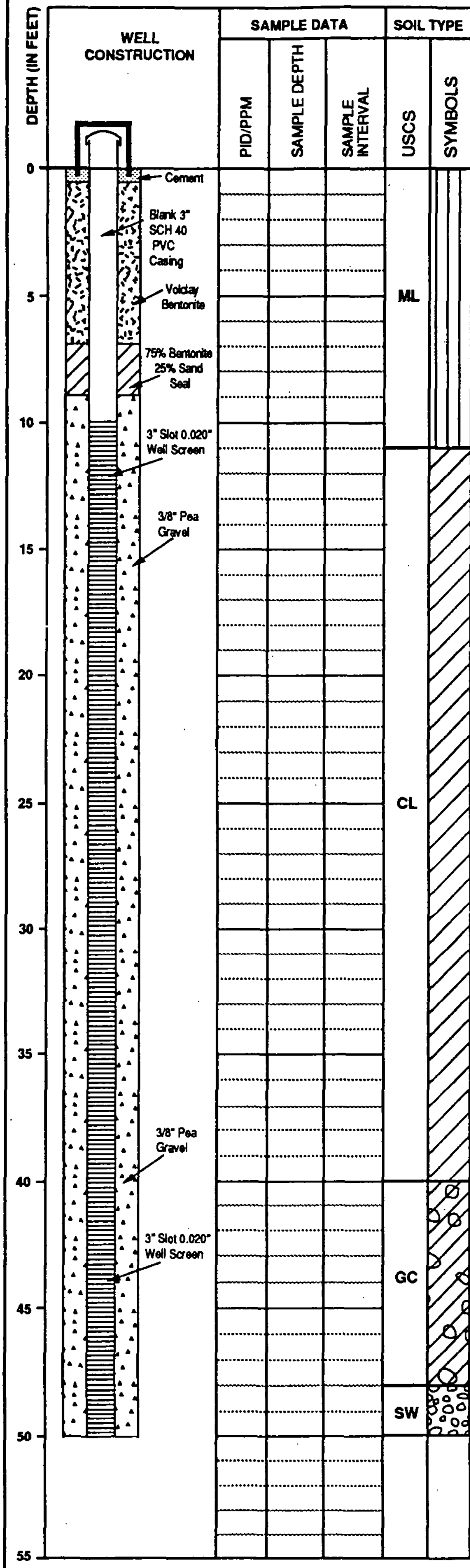
CLIENT: Goodyear Tire and Rubber | **JOB NUMBER:** 017761

DRILLING METHOD: 6.25" Hollow Stem Auger; CME 75HT

GEOLOGIST: M. Joe Weidmann

CONTRACTOR: Heber Mining & Exploration | **START DATE:** 10/30/95 | **TIME:** 1205

DRILLER: Randy Wilder | **FINISH DATE:** 10/30/95 | **TIME:** 1325



0-5' Light brown, sandy SILT (ML), trace gravel, dry.

5-10' As above, hard caliche from 7-8'.

10-15' As above, hard caliche from 10-11', becomes brown, silty CLAY(CL) at ~11', slightly damp.

15-20' Brown, CLAY (CL), little silt, slightly damp.

20-25' As above.

25-30' Brown, CLAY (CL), trace silt, slightly damp.

30-35' Brown, CLAY (CL), slightly damp.

35-40' Brown, CLAY (CL), little silt, slightly damp.

40-45' Becomes GRAVELLY CLAY to CLAYEY GRAVEL (GC) at ~40', little coarse sand, trace silt, damp.

45-50' As above, little coarse sand, becomes medium to very coarse SAND (SW) at ~48', trace gravel, moist.

Total depth of 50' below ground surface.
No groundwater encountered.
No odors or PID readings encountered during drilling.

BORING VEW-92-2

Phoenix-Goodyear Airport

Metcalf & Eddy

CLIENT: Goodyear Tire and Rubber **JOB NUMBER:** 017761

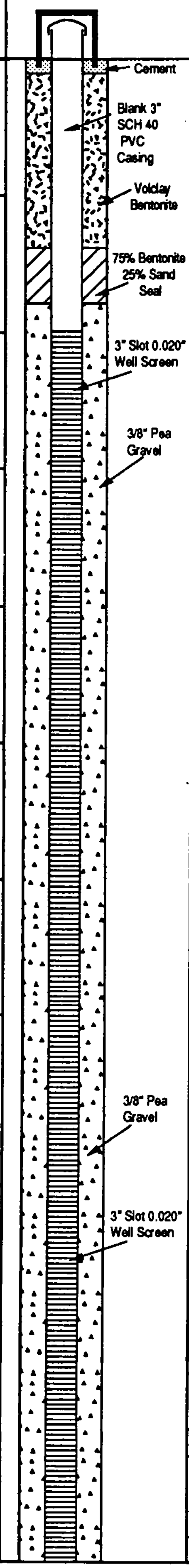
DRILLING METHOD: 8.25" Hollow Stem Auger; CME 75HT

GEOLOGIST: M. Joe Weidmann

CONTRACTOR: Heber Mining & Exploration **START DATE:** 9/28/95 **TIME:** 0745

DRILLER: Dan Hatcher **FINISH DATE:** 9/28/95 **TIME:** 1430

DEPTH (IN FEET) | WELL CONSTRUCTION | SAMPLE DATA: PID/PPM, SAMPLE DEPTH, SAMPLE INTERVAL | SOIL TYPE: USCS, SYMBOLS



Depth (ft)	USCS	Description
0–5	SM	0-5' Light brown, silty sand to sandy SILT (SM), trace to little gravel, trace to localized hard caliche, dry.
5–7	ML	5-10' SILT (ML), grades to a CLAY (CL), at ~7', trace to little hard caliche, caliche layer at ~7', dry.
7–25	CL	10-15' Brown, CLAY (CL), little to some silt, caliche layer at ~12', slightly damp.
		15-20' Brown, CLAY (CL), trace to little silt, damp.
		20-25' Brown, CLAY (CL), increasing silt towards 25', caliche from ~22-24', damp.
25–29	ML	25-30' Brown, SILT (ML), grading to a SILTY SAND/SANDY SILT (SM), at ~29'.
29–32	SM	30-32' Sandy SILT (ML), slightly damp.
32–39	SW	32-39' Fine to coarse SAND (SW), well-graded, gravel layer at ~36-37.
39–46	CL	39-46' Brown, CLAY (CL), trace to little silt, trace sand, damp.
46–55	GC	46-50' CLAYEY GRAVELS to GRAVELLY CLAYS (GC), trace silt, little sand, damp.
		50-55' Same as above, slightly moist.

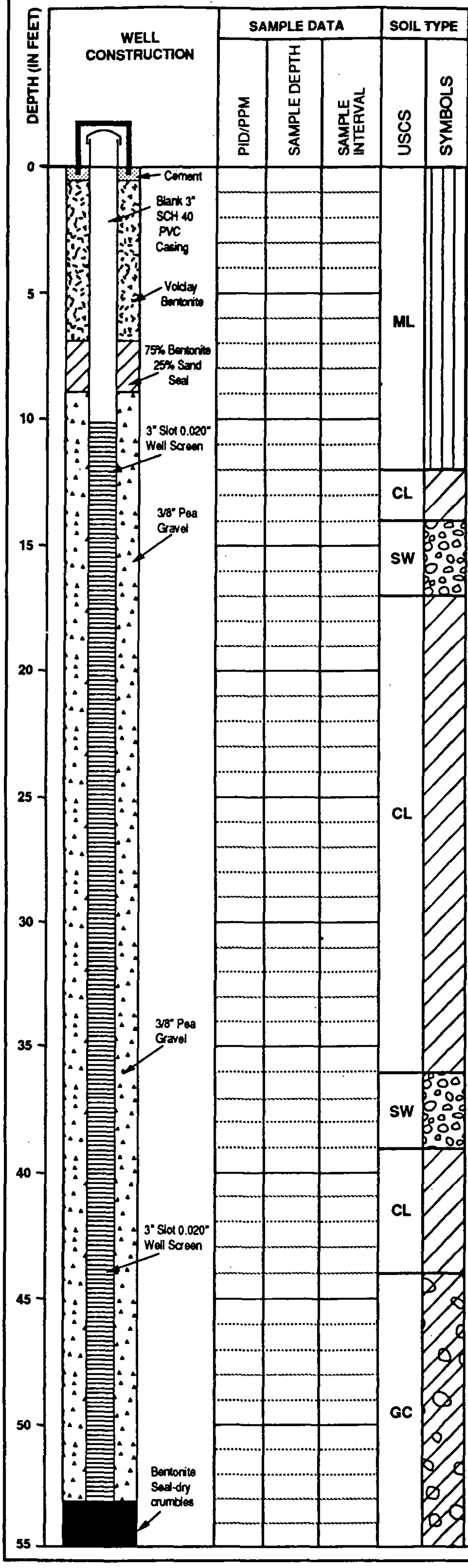
Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55

Total depth of 55' below ground surface.
No groundwater encountered.
No odors or PID readings encountered during drilling.

BORING VEW-92-3

Phoenix-Goodyear Airport

CLIENT: Goodyear Tire and Rubber **JOB NUMBER:** 017761
DRILLING METHOD: 8.25" Hollow Stem Auger; CME 75HT
GEOLOGIST: M. Joe Weidmann
CONTRACTOR: Heber Mining & Exploration **START DATE:** 9/27/95 **TIME:** 094
DRILLER: Dan Hatcher **FINISH DATE:** 9/27/95 **TIME:** 133



0-12' Lt. brown, SILT (ML), trace to little sand, trace to little silt, dry, increasing clay and decreasing sand towards 8' caliche layer hard at ~8'.

12-14' Brown, CLAY (CL), little silt, trace sand, slightly damp.

14-17' Brown, silty fine to medium SAND (SW), trace coarse sand, slightly damp.

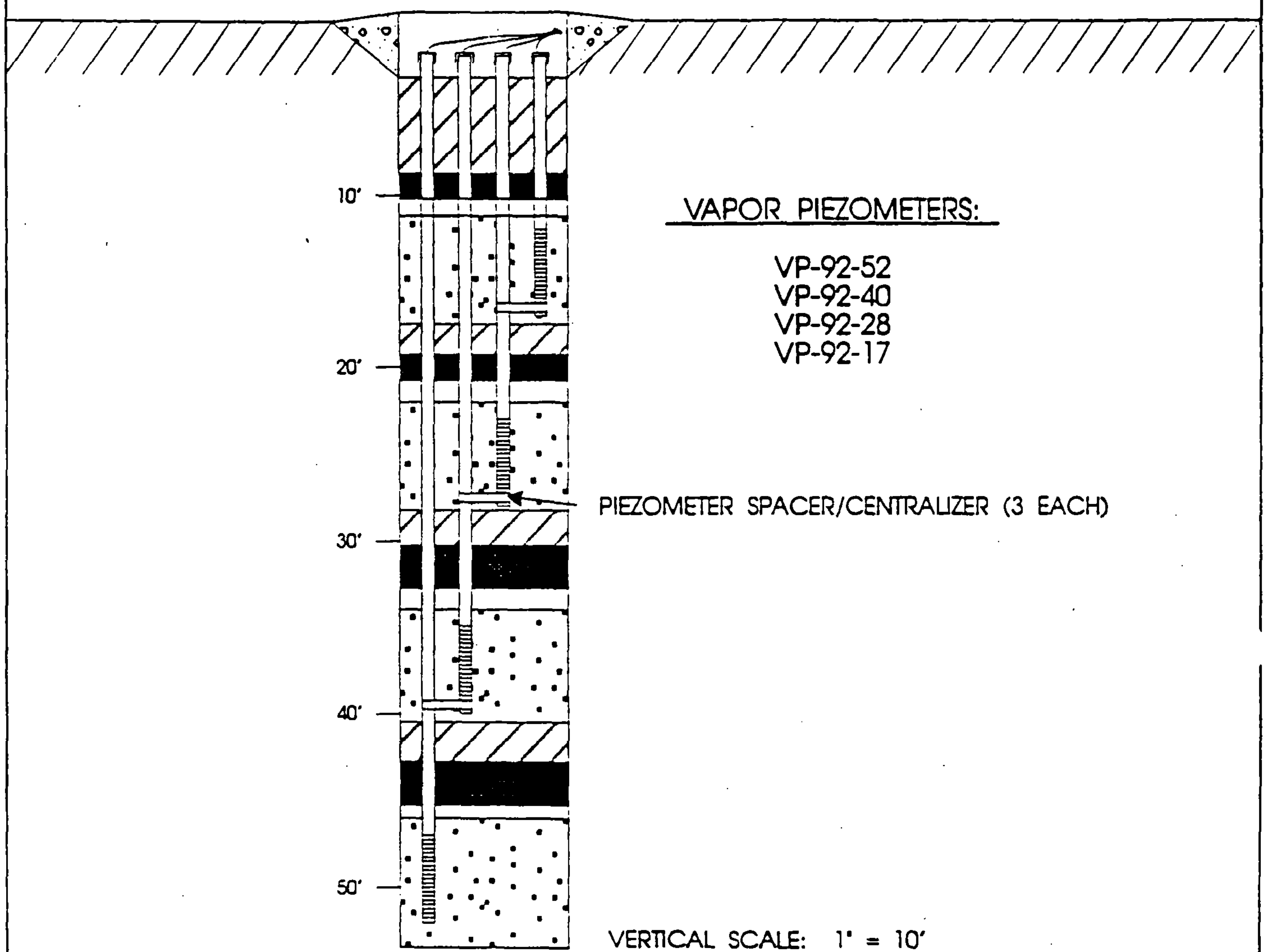
17-36' Brown, CLAY (CL), little to some silt at top of interval, trace fine to medium sand at top of interval, slightly damp to damp, hard caliche at ~22', increasing silt and fine to medium sand at the bottom of interval

36-39' Silty fine to medium SAND (SW), gravels at 39', slightly damp.

39-44' Brown SILTY CLAY to CLAY (CL), trace to little sand, damp.

44-55' GRAVELLY CLAYS to CLAYEY GRAVELS (GC), trace to little sand and silt, slightly moist to moist, very moist at bottom.

Total depth of 55' below ground surface.
Groundwater encountered at ~54.5' below ground surface.
No odors or PID readings encountered during drilling.



VAPOR PIEZOMETERS:

VP-92-52
VP-92-40
VP-92-28
VP-92-17

VERTICAL SCALE: 1" = 10'

EXPLANATION

(blank box)	GROUT - PORTLAND CEMENT AND 5% VOCLAY BENTONITE
(hatched box)	BENTONITE SEAL - 75% 8-12 BENTONITE CHIPS AND 25% 8-12 SAND
(dotted box)	SAND SEAL - COLORADO #30 SILICA
(black box)	GRAVEL PACK - COLORADO 8-12 SILICA

* ALL PIEZOMETERS CONSTRUCTED OF 1/2" ID SCH 40 PVC WITH 5 FT. LENGTH OF 0.02" MACHINE SLOT SCREEN

PROJECT: Phoenix - Goodyear Airport

TITLE: Well Construction Log VP-92

CLIENT: Goodyear Tire & Rubber

LOCATION: VB-92

JOB NUMBER: 6791-0001

Metcalf & Eddy

VP-92

PAGE	JOB NUMBER	CLIENT	LOCATION
1 OF 2	006791-0001	GOODYEAR TIRE AND RUBBER	VB-92

DRILLING METHOD 8.25" I.D. HOLLOW STEM AUGER

SAMPLING METHOD 2.5" O.D. CME CONTINUOUS CORE BARREL - IN AUGE[R]

CONTRACTOR HEBER MINING AND EXPLORATION - CME 75HT

START DATE: 5/26/92 TIME: 0845

DRILLER RANDY ENGINEER ZACHARY WEATHER SUNNY 95°F

FINISH DATE: 5/26/92 TIME: 1505

DEPTH (FEET)	SAMPLER TYPE	IN. DRIVEN/RECOVERED	SAMPLE NUMBER(DEPTH)	RECOVERED INTERVAL	TIME	BLOWS PER 6 INCHES	SAMPLE VAPORS (PID IN PPM)	SOIL GRAPH	DESCRIPTION
0	SOIL	60/60	N/A		0920	N/A	N/A		SURFACE: DIRT - UNGRADED AND FLAT MED. BROWN (10YR 6/8), MED. TO FINE SANDY SILT WITH TRACE CRS. SAND AND ANGULAR FINE TO MED. GRAVEL DRY
4	SOIL	60/26	N/A		0925	N/A	N/A		MED. BROWN (10YR 6/8), MED. TO FINE SANDY SILT TO SILTY SAND, TRACE CRS. SAND AND FINE TO CRS. GRAVEL DRY
8									8.5' - (10YR 8/3), TRANSITION TO CEMENTED SILTY SAND WITH PART. CALICHIFICATION (50%), DRY TO MOIST
9	SOIL	60/30	N/A		1000	N/A	N/A	SM	LT. BROWN, SILTY SAND TO SANDY SILT WITH WHITE CALICHE AT 10.75-11.50' BGS
14	SOIL	60/60	N/A		1010	N/A	N/A		LT. TO MED. BROWN (10YR 8/3), FINE SANDY SILT WITH WHITE CALICHE IN VEINS, MOTTLED, CALICHE APPROX. 30-40%, MOIST
19	SOIL	60/60	N/A		1025	N/A	N/A	SC CL	BROWN, CLAYEY COARSE SAND (19-20'), GRADES TO BROWN (10YR 6/8), CLAYEY VERY FINE SAND AND SILT WITH APPROX. 20-30% CALICHE IN VEINS (21.5-22.5'), MOIST
24	SOIL	60/30	N/A		1055	N/A	N/A	SM	LT. BROWN (10 YR 8/3), MED. SILTY SAND WITH SOME CLAY, TRACE TO SOME (<10%) CALICHE IN VEINS, MOIST TO DRY
27									LT. BROWN, SILTY SAND AND CALICHE (50%), INDURATED AND IN VEINS
29	SOIL	60/36	N/A		1105	N/A	N/A	SP	LT. BROWN (10YR 8/3), MED. SAND WITH TRACE CALICHE IN VEINS (<10%), SLIGHTLY MOIST TO MOIST
34	SOIL	60/30	N/A		1130	N/A	N/A	SM	BROWN (10YR 3/3), COARSE SILTY SAND WITH SOME CRS. GRAVELS, SUB-ANGULAR TO SUB-ROUNDED, TO FINE COBBLES, MOIST

VP-92

PAGE	JOB NUMBER	CLIENT	LOCATION
2 OF 2	006791-0001	GOODYEAR TIRE AND RUBBER	VB-92

DRILLING METHOD 8.25" I.D. HOLLOW STEM AUGER

SAMPLING METHOD 2.5" O.D. CME CONTINUOUS CORE BARREL - IN AUGER

CONTRACTOR HEBER MINING AND EXPLORATION - CME 75HT

DRILLER RANDY **ENGINEER** ZACHARY **WEATHER** SUNNY 95°F

START DATE 5/26/92 **TIME** 0845

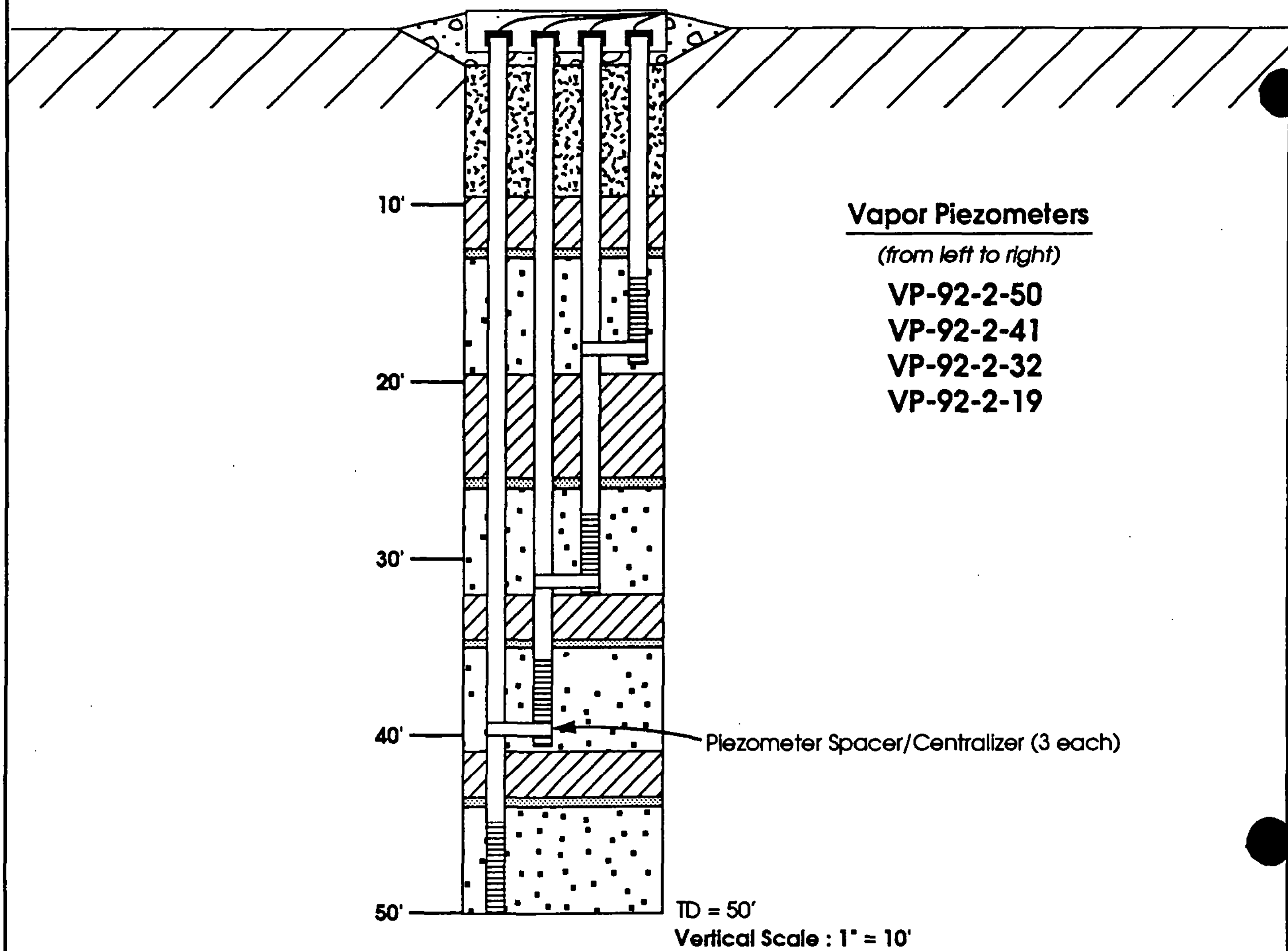
FINISH DATE 5/26/92 **TIME** 1505

DEPTH (FEET)	SAMPLER TYPE	IN. DRIVEN/RECOVERED	SAMPLE NUMBER(DEPTH)	TIME	BLOWS PER 6 INCHES	SAMPLE VAPORS (PID IN PPM)	SOIL GRAPH	DESCRIPTION
35–36							SM	
37–38							CL	DK. BROWN (10YR 3/3), SILTY CLAY WITH TRACE CRS. GRAVEL SUB-ANGULAR TO SUB-ROUNDED, MOIST
39	SOIL	60/48	N/A	1150	N/A	N/A	SP	BROWN (10YR 6/8), CRS. SAND WITH TRACE FINE TO MED. GRAVEL SUB-ANGULAR TO SUB-ROUNDED, MOIST TO VERY MOIST
43							GP	SOME CRS. GRAVELS AT 43' BGS
44	SOIL	60/27	N/A	1215	N/A	N/A	GM	LT. BROWN TO MED. BROWN (10YR 8/3 TO 10YR 6/8), SILTY TO FINE TO MED. SANDY GRAVELS (0.2-3 CM) SUB-ANGULAR TO SUB-ROUNDED, TRACE SILT, MOIST TO VERY MOIST, FRIABLE
49	SOIL	60/9	N/A	1230	N/A	N/A	GP	DK. BROWN (10YR 3/3), WITH BANDS OF RED (10R 3/6) AND GREEN (5G 6/1), VERY CRS. GRAVEL (0.2-5 CM) SUB-ANGULAR, AND SANDS WITH TRACE MED. SANDS, GRAVEL HIGHLY WEATHERED AND FRIABLE
54								MED. BROWN TO DK. BROWN (10YR 6/8 TO 10YR 3/3), CRS. TO VERY CRS. GRAVLES (0.2-5 CM) ANGULAR, AND CRS. SAND WITH SOME FINE COBBLES, VERY MOIST
57	SOIL	10/10	57	1407	43/72(4")	N/A		MED. BROWN (10YR 3/3), CRS. GRAVEL (0.2-5 CM) ANGULAR TO SUB-ANGULAR, AND CRS. TO MED. SAND, GRAVELS FRIABLE. SATURATED

WATER LEVEL AT 54.45' BGS AT 1500 ON 5/26/92

▽ DENOTES MEASURED WATER TABLE DEPTH

Depth scale: 35–70 feet.



EXPLANATION

Redi-Mix Cement

Grout-
95% Portland Cement and
5% Volclay Bentonite

Bentonite Seal-
Dry crumbles to seal water table

Bentonite Seal-
75% Bentonite Chips and
25% 8-12 Sand

Sand Seal-
Colorado #30 Silica

Gravel Pack-
Colorado 8-12 Silica

Note: All Piezometers constructed of 1/2" ID SCH 40 PVC with 5 ft. length of 0.02" machine slot screen

Note 2: All Piezometer names reference bottom of screened interval

PROJECT: Phoenix-Goodyear Airport
TITLE: Well Construction Log VP-92-2
CLIENT: Goodyear Tire & Rubber
LOCATION: VP-92-2
JOB NUMBER: 017761

Metcalf & Eddy

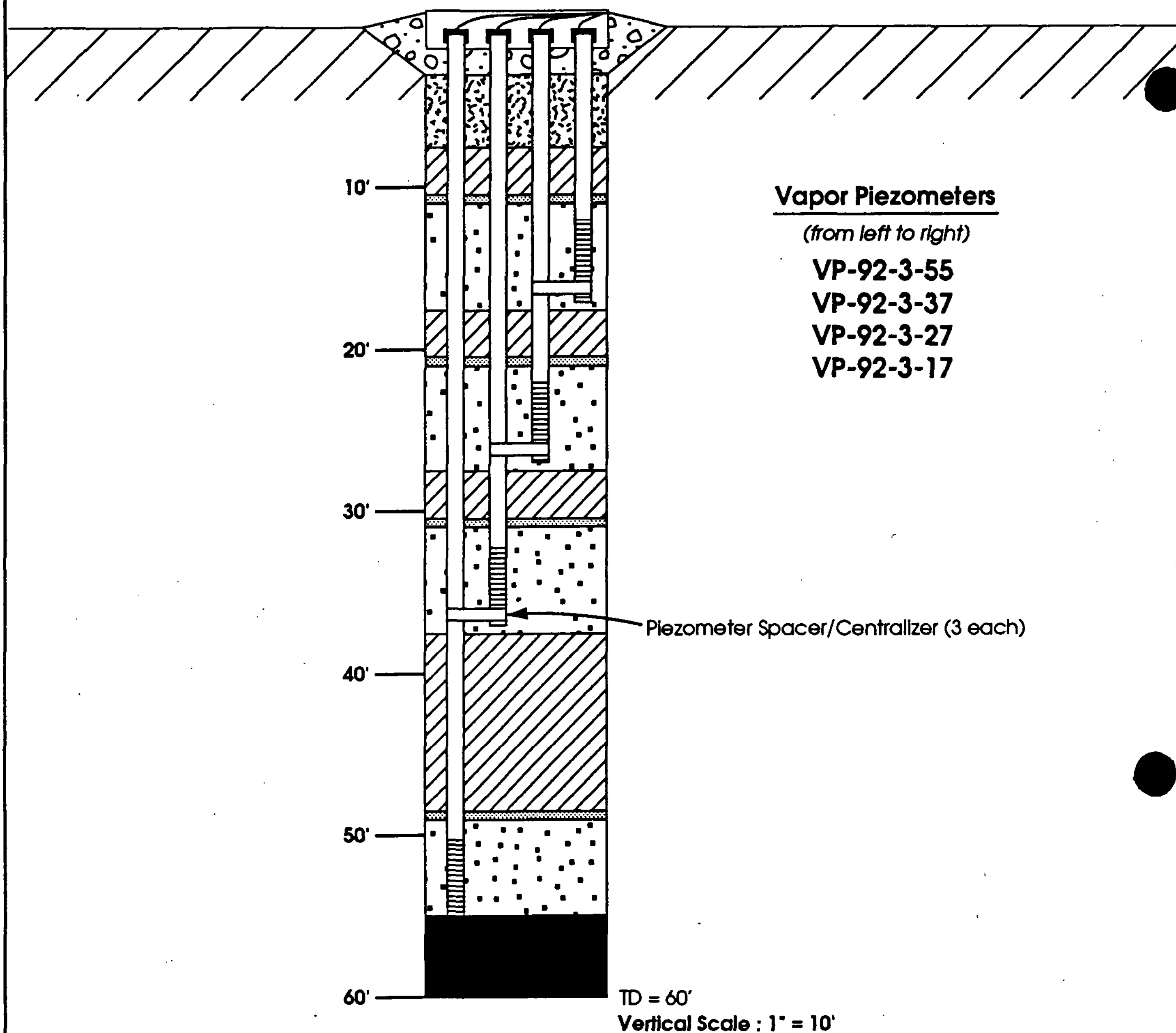
BORING VP-92-2

Phoenix-Goodyear Airport

Metcalf & Eddy

CLIENT: Goodyear Tire and Rubber
JOB NUMBER: 017661
DRILLING METHOD: 8.25" Hollow Stem Auger; CME 75HT
GEOLOGIST: M. Joe Weidmann
CONTRACTOR: Heber Mining & Exploration
START DATE: 10/31/95 **TIME:** 0915
DRILLER: Randy Wilder
FINISH DATE: 10/31/95 **TIME:** 1205

DEPTH (IN FEET)	SAMPLE DATA: IN. RECOVERED/ IN. DRIVEN	BLOWS PER 6 INCHES	PID/PPM	SAMPLE DEPTH	SAMPLE TYPE	TIME	SOIL TYPE: USCS	DESCRIPTION
0							ML	0-5' Grass at surface, roots to about 2 or 3'. Silty clay to clayey SILT (ML) to 5'.
5							ML	5-10' Light brown, clayey SILT (ML), slightly damp, hard caliche from 8-10'.
10							ML	10-15' Light brown, SILT, some clay, slightly damp, hard caliche from 10-14', brown, silty CLAY (CL), begins at 14', slightly damp.
15							CL	15-20' Brown, CLAY (CL), little silt, slightly damp.
20							CL	20-25' Brown, CLAY (CL), little silt, slightly damp.
25	18/18	12/28/39	0	25	SS	1025	ML	25-26.5' Brown, silty clay to clayey SILT (ML), slightly damp.
							ML	26.5-30' Brown, silty clay to clayey SILT (ML), slightly damp.
30	18/18	10/17/38	0	30	SS	1045	ML	30-31.5' Brown, clayey SILT (ML), slightly damp.
							ML / CL	31.5-35' As above, clay from ~32-34'.
35	18/18	16/19/23	0	35	SS	1105	ML	35-36.5' Brown, silty clay to clayey SILT (ML), brief interval of fine to medium sand, trace coarse sand, slightly damp.
							GW	36.5-40' As above, coarse sand and GRAVEL (GW) begins at ~37', little fine to medium sand, trace silt, slightly damp.
40	16/16	19/27/50 (4")	0	40	SS	1125	GW	40-41.5' Coarse sand and GRAVEL (GW), little fine to medium sand, trace silt, slightly damp.
							GW	41.5-45' As above, becomes CLAYEY GRAVEL (GC) at ~44', some silt, little sand, slightly damp.
45	18/17	17/28/36	0	45	SS	1140	GC	45-46.5' Coarse sand and GRAVEL (GC), with intervals of brown, silty clay, little fine to medium sand, damp.
							GC	46.5-50' CLAYEY GRAVEL (GC), little coarse sand, moist.
50								Total depth 50' below ground surface. No groundwater encountered. No odors or PID reading encountered.
55								



EXPLANATION

- **Redi-Mix Cement**
- **Grout-** 95% Portland Cement and 5% Volclay Bentonite
- **Bentonite Seal-** Dry crumbles to seal water table
- **Bentonite Seal-** 75% Bentonite Chips and 25% 8-12 Sand
- **Sand Seal-** Colorado #30 Silica
- **Gravel Pack-** Colorado 8-12 Silica

Note: All Piezometers constructed of 1/2" ID SCH 40 PVC with 5 ft. length of 0.02" machine slot screen

Note 2: All Piezometer names reference bottom of screened interval

PROJECT: Phoenix-Goodyear Airport
TITLE: Well Construction Log VP-92-3
CLIENT: Goodyear Tire & Rubber
LOCATION: VP-92-3
JOB NUMBER: 017761

Metcalf & Eddy

BORING VP-92-3

Phoenix-Goodyear Airport

M&E Metcalf & Eddy

CLIENT: Goodyear Tire and Rubber **JOB NUMBER:** 017761

DRILLING METHOD: 8.25" Hollow Stem Auger; CME 75HT

GEOLOGIST: M. Joe Weidmann

CONTRACTOR: Heber Mining & Exploration **START DATE:** 9/26/95 **TIME:** 0730

DRILLER: Dan Hatcher **FINISH DATE:** 9/26/95 **TIME:** 1400

DEPTH (IN FEET)	SAMPLE DATA: IN. RECOVERED/ IN. DRIVEN	BLOWS PER 6 INCHES	PID/PPM	SAMPLE DEPTH	SAMPLE TYPE	TIME	SOIL TYPE: USCS	DESCRIPTION
0							ML	0-5' Lt. brown, SILT (ML), with little fine sand and trace to little clay, dry.
5							ML	5-15' SILT (ML), little fine sand and little clay, decreasing sand and increasing clay towards 15', little hard caliche from ~8-10', dry.
10							ML	
15							CL	15-20' Brown, CLAY (CL), trace to little silt, slightly damp.
20							ML	20-25' Brown, clayey SILT (ML), increasing sand and decreasing clay towards 25', slightly damp.
25	18/18	14/15/19	0	25	SS	0814	SW	25-26.5' Brown, silty fine to medium SAND (SW), trace coarse sand, slightly damp, trace localized caliche, grading to a fine to coarse well-graded sand, trace to little silt. 26.5-30' Fine to coarse well-graded SAND (SW), slightly damp.
30	18/18	11/19/21	0	30	SS	0840	SW	30-31.5' Brown, fine to coarse well-graded SAND (SW), trace very coarse sand, trace fine gravel, slightly damp, trace to little fine to coarse gravel at ~26', intervals of silt and clay towards ~26.5'. 31.5-37' Brown, fine to coarse well-graded SAND (SW), slightly damp, gravels encountered ~34'.
35							SW	
40							CL	37-43' Brown, CLAY (CL), trace to little silt, damp, gravels/cobbles encountered at ~39-40'.
							GW	43-45' Gravel/cobble layer.
45	18/18	11/41/50	0	45	SS	0935	GW / SW	45-46.5' SANDY, GRAVEL AND COBBLES (GW), trace to little silt and clay, damp to slightly moist, contact at ~46.25' to a brown, medium to coarse, well-graded SAND (SW), little to some fine sand. trace silt, little to some very coarse sand, trace to little fine gravel. 46.5-47' Well-graded SAND (SW), slightly moist. 47-48' Gravel and cobbles.
50							GC	48-60' CLAYEY GRAVELS to GRAVELLY CLAYS (GC), little sand, little silt, cobbles towards bottom, moist, wet at bottom.
55								

BORING VP-92-3 (cont'd.)

Phoenix-Goodyear Airport

M&E Metcalf & Eddy

CLIENT: Goodyear Tire and Rubber **JOB NUMBER:** 017761

DRILLING METHOD: 8.25" Hollow Stem Auger; CME 75HT

GEOLOGIST: M. Joe Weidmann

CONTRACTOR: Heber Mining & Exploration **START DATE:** 9/26/95 **TIME:** 0730

DRILLER: Dan Hatcher **FINISH DATE:** 9/26/95 **TIME:** 1400

DEPTH (IN FEET)	SAMPLE DATA: IN. RECOVERED/ IN. DRIVEN	BLOWS PER 6 INCHES	PID/PPM	SAMPLE DEPTH	SAMPLE TYPE	TIME	SOIL TYPE: USCS	SYMBOLS	Description
55–60							GC		
60									Total depth of 60' below ground surface. Groundwater encountered at 59' below ground surface. No odors or PID readings encountered during drilling.
65									
70									
75									
80									
85									
90									
95									
100									
105									
110									

BORING VEW-27A-1

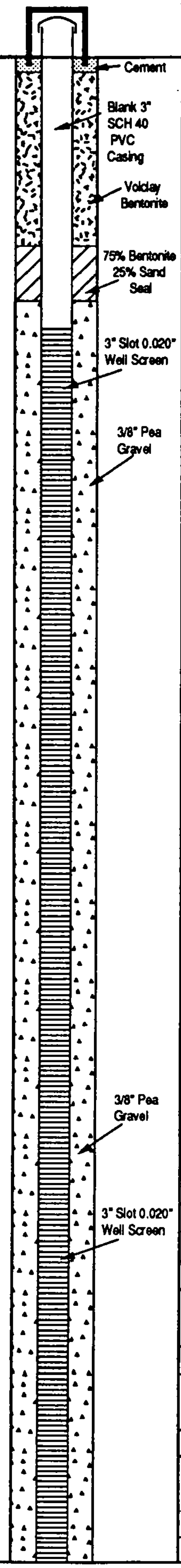
Phoenix-Goodyear Airport

Metcalf & Eddy

CLIENT: Goodyear Tire and Rubber **JOB NUMBER:** 017761
DRILLING METHOD: 6.25" Hollow Stem Auger; CME 75HT
GEOLOGIST: M. Joe Weidmann
CONTRACTOR: Heber Mining & Exploration **START DATE:** 9/29/95 **TIME:** 1230
DRILLER: Dan Hatcher/Randy Wilder **FINISH DATE:** 10/2/95 **TIME:** 1050

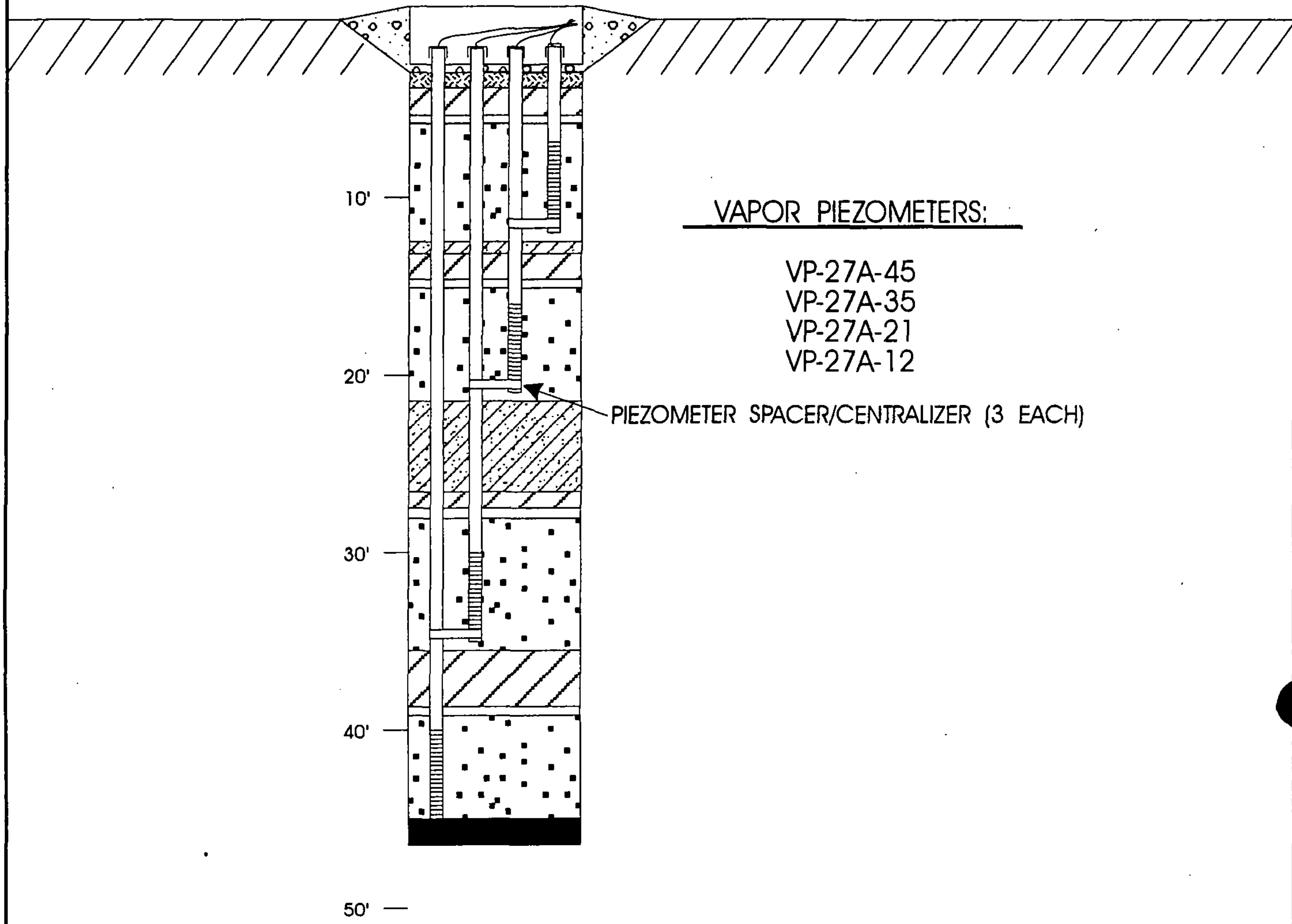
DEPTH (IN FEET): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55

WELL CONSTRUCTION



SAMPLE DATA: PID/PPM	SAMPLE DEPTH	SAMPLE INTERVAL	SOIL TYPE: USCS	Description
			ML	0-9' Light brown, fine sandy SILT (ML), dry.
			ML	9-11' Brown, clayey SILT (ML), dry.
			CL	11-20' Brown, CLAY (CL), to silty clay, slightly damp.
			CL	20-25' Brown, CLAY (CL), to silty clay, damp.
			CL	25-30' Brown, CLAY (CL), to silty clay, damp.
			CL	30-32' Brown, CLAY to SILTY CLAY, gravels at ~31'. At 32' becomes a fine to medium, well-graded sand, little silt, little coarse sand, trace gravel.
			SW	32-38' Fine to medium, well-graded SAND (SW), little silt, little coarse sand, trace gravel, slightly damp.
			GC	38-55' CLAYEY GRAVEL to GRAVELLY CLAY (GC), trace to little sand, trace silt, coarser gravels and cobbles at ~50'.

Total depth of 55' below ground surface.
No groundwater encountered.
No odors or PID readings encountered during drilling.



VERTICAL SCALE: 1" = 10'

EXPLANATION

- BENTONITE SEAL - 50% BENTONITE CHIPS AND 50% 8-12 SAND
- GROUT - PORTLAND CEMENT AND 5% VOLCLAY BENTONITE
- BENTONITE SEAL - DRY CRUMBLES TO SEAL WATER TABLE
- BENTONITE SEAL - 75% BENTONITE CHIPS AND 25% 8-12 SAND
- SAND SEAL - COLORADO #30 SILICA
- GRAVEL PACK - COLORADO 8-12 SILICA

* ALL PIEZOMETERS CONSTRUCTED OF 1/2" ID SCH 40 PVC WITH 5 FT. LENGTH OF 0.02" MACHINE SLOT SCREEN

PROJECT: Phoenix - Goodyear Airport

TITLE: Well Construction Log VP-27A

CLIENT: Goodyear Tire & Rubber

LOCATION: VP-27A

JOB NUMBER: 012014-0001

M&E Metcalf & Eddy

VP-27A

PAGE	JOB NUMBER	CLIENT	LOCATION
1 OF 2	012014-0001	GOODYEAR TIRE AND RUBBER	VP-27A

DRILLING METHOD 8.25" I.D. HOLLOW STEM AUGER

SAMPLING METHOD 2" ID X 18" CAL. MODIFIED SPLIT SPOON SAMPLER

CONTRACTOR HEBER MINING AND EXPLORATION - CME 75HT

DRILLER KEVIN **ENGINEER** WEIDMANN/SPRINGER

START DATE: 7/14/93 **TIME:** 0615

FINISH DATE: 7/14/93 **TIME:** 0840

DEPTH (FEET)	SAMPLER TYPE	IN. DRIVEN/RECOVERED	RECOVERED INTERVAL	SAMPLE NUMBER(DEPTH)	TIME	BLOWS PER 6 INCHES	SAMPLE VAPORS (PID IN PPM)	SOIL GRAPH	DESCRIPTION
5	SOIL	18/18		5	0630	12/18/23	18.2	CL	LIGHT BROWN (10YR 8) TO BROWN (10YR 6/8), SILTY CLAY, CL, HARD, DRY TO SLIGHTLY MOIST, TRACE MILDLY FORMED CALICHE, SOME ROOTS
10	SOIL	18/18		10	0642	8/15/28	22.7		BROWN (10YR 6/8), SILTY CLAY, CL, HARD, SLIGHTLY MOIST, SOME WELL FORMED CALICHE, TRACE EUHEDRAL GYPSUM CRYSTALS
15	SOIL	18/15		15	0700	4/10/13	69.3	SW	BROWN (10YR 6/8) TO YELLOWISH RED (5YR 4/6), SAND, SW, WELL GRADED, MEDIUM DENSE, MOIST
20	SOIL	18/18		20	0710	7/12/38	14.1	CL	YELLOWISH RED (5YR 4/6), SILTY CLAY, CL, HARD, MOIST, CALICHE IN NOSE OF SAMPLER, TRACE BLACK ORGANIC MATERIAL
25	SOIL	18/18		25	0725	10/17/24	16.2	ML	YELLOWISH RED (5YR 4/6), CLAYEY SILT, ML, HARD, MOIST, VERY FAINT ODOR
30	SOIL	18/16		30	0740	6/12/20	142	SW	BROWNISH YELLOW (10YR 6/8), SILTY SAND, SM, WELL GRADED, HARD, MOIST, BLACK STAINED AT ~30 TO ~30.5 FEET, SLIGHT ODOR
34								SP	

VP-27A

PAGE 2 OF 2

JOB NUMBER	CLIENT	LOCATION
012014-0001	GOODYEAR TIRE AND RUBBER	VP-27A

DRILLING METHOD 8.25" I.D. HOLLOW STEM AUGER

SAMPLING METHOD 2" ID X 18" CAL. MODIFIED SPLIT SPOON SAMPLER

CONTRACTOR HEBER MINING AND EXPLORATION - CME 75HT

DRILLER KEVIN ENGINEER WEIDMANN/SPRINGER

START DATE: 7/14/93 TIME: 0615

FINISH DATE: 7/14/93 TIME: 0840

DEPTH (FEET)	SAMPLER TYPE	IN. DRIVEN/RECOVERED	RECOVERED INTERVAL	SAMPLE NUMBER(DEPTH)	TIME	BLOWS PER 6 INCHES	SAMPLE VAPORS (PID IN PPM)	SOIL GRAPH	DESCRIPTION
35	SOIL	18/18		35	0800	8/22/38	58.7	SP	LIGHT GRAY (N 7), FINE TO MEDIUM SAND, SP, POORLY GRADED, VERY DENSE, MOIST, NO ODOR
36									
37									
38									
39									
40	SOIL	11/11		40	0815	21/50	18.7	SW	YELLOWISH RED (5YR 4/6), SAND, SW, WELL GRADED, SOME ROUND TO ANGULAR GRAVEL, VERY DENSE, MOIST TO VERY MOIST, COBBLE IN NOSE OF SAMPLER
41									
42									
43									
44									
45	SOIL	12/11		45	0840	29/50	NS		YELLOWISH RED (5YR 4/6), SAND, SW, WELL GRADED, SOME ANGULAR GRAVELS AND COBBLES, VERY DENSE, VERY MOIST, SAMPLER REFUSAL AT ~46 FEET LIKELY DUE TO COBBLES
46									
47									
48									
49									
50									
51									
52									
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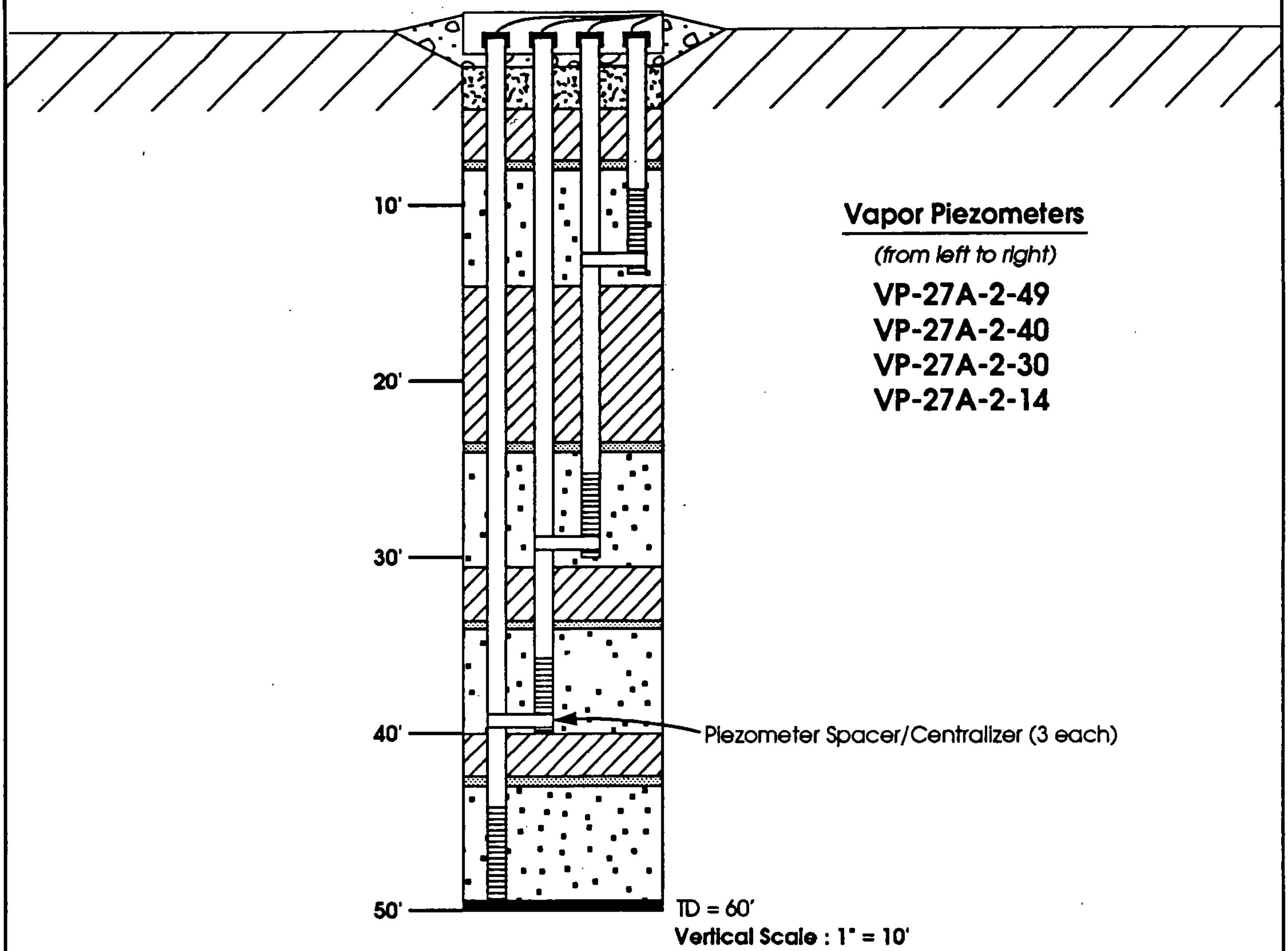
70									



EXPLANATION

Redi-Mix Cement

Grout-
95% Portland Cement and
5% Volclay Bentonite

Bentonite Seal-
Dry crumbles to seal water table

Bentonite Seal-
75% Bentonite Chips and
25% 8-12 Sand

Sand Seal-
Colorado #30 Silica

Gravel Pack-
Colorado 8-12 Silica

Note: All Piezometers constructed of 1/2" ID SCH 40 PVC with 5 ft. length of 0.02" machine slot screen

Note 2: All Piezometer names reference bottom of screened interval

PROJECT: Phoenix-Goodyear Airport

TITLE: Well Construction Log VP-27A-2

CLIENT: Goodyear Tire & Rubber

LOCATION: VP-27A-2

JOB NUMBER: 017761

Metcalf & Eddy

BORING VP-27A-2

Phoenix-Goodyear Airport

CLIENT: Goodyear Tire and Rubber **JOB NUMBER:** 017761

DRILLING METHOD: 8.25" Hollow Stem Auger; CME 75HT

GEOLOGIST: M. Joe Weidmann

CONTRACTOR: Heber Mining & Exploration **START DATE:** 10/4/95 **TIME:** 1205

DRILLER: Randy Wilder **FINISH DATE:** 10/4/95 **TIME:** 1430

Metcalf & Eddy

DEPTH (IN FEET)	SAMPLE DATA: IN. RECOVERED/ IN. DRIVEN	BLOWS PER 6 INCHES	PID/PPM	SAMPLE DEPTH	SAMPLE TYPE	TIME	SOIL TYPE: USCS	DESCRIPTION
0							ML	0-5' Lt. brown, SILT (ML), dry, gravel and cobbles encountered at ~2'
5							ML	5-10' Light brown, SILT (ML), dry, hard caliche at ~8', becomes brown, clayey SILT (ML), at ~9', slightly damp.
10							ML	10-15' Brown, clayey SILT (ML), hard caliche at ~12', becomes clay at ~13', slightly damp.
15							CL	15-20' Brown, CLAY (CL), trace silt, damp.
20							CL	20-25' Brown, clay to silty CLAY (CL), damp.
25	18/18	9/12/15	0	25	SS	1242	CL	25-26.5' Brown, clay to silty CLAY (CL), damp.
							CL	26.5-30' Brown, clay to silty CLAY (CL), damp.
30	18/18	15/28/39	0	30	SS	1256	SW	30-31.5' Reddish brown, silty fine to medium SAND (SW), trace coarse sand, grades at 30.25' to a brown, silty clay to clayey silt (ML), damp.
							ML	31.5-35' Brown, silty clay to clayey SILT (ML), damp.
35	18/18	14/17/23	0	35	SS	1311	CL	35-36.5' Brown, silty CLAY (CL), trace fine to medium sand, damp, ~30% of sample fine to medium sand, little coarse sand, trace gravel, filling vertical to diagonal fractures.
							SW	36.5-40' Silty fine to medium SAND (SW), little coarse sand, gravels and cobbles at ~36', slightyl damp.
40	18/12	16/29/36	0	40	SS	1330	SW	40-41.5' Brown, fine to medium SAND (SW), trace to little coarse sand, trace fine to coarse gravel, slightly damp.
							GW	41.5-45' As above, GRAVEL and SAND (GW) begin at ~42'.
45	18/12	40/38/30	0	45	SS	1350	SW	45-46.5' Light brown, fine to medium SAND (SW), little coarse sand, damp.
							GC	46.5-50' Clayey GRAVEL (GC), minor sand, moist at 50'.
50								Total depth 50' below ground surface. No groundwater encountered. No odors or PID reading encountered.
55								

ORIFICE PLATE FLOW ELEMENT

CALCULATION SHEETS

cmc #1)

1" SCH 40

LAMBDA SQUARE, INC.
LSI FLOW METERING
P.O. BOX 1119-M - BAY SHORE, NY 11706
(516) 587-1000 - FAX (516) 587-1011

ORIFICE2 (Ver 1.52) FLOW ELEMENT CALCULATION

Tag.....:	AGRA/M&E 1" SCH 40		
Spec No.:		Date..........:	10/27/95 14:13
Line No.:		Equipment No..:	
Customer:		Customer PO...:	
Project#:		Shop Order....:	
Revision:		Revised By....:	
CalcType:	Beta Ratio	Fluid State...:	Gas

Calculation Equ Ref: Flow Measurement Engr Handbook, 2nd Ed.

Fluid AIR

Element....,	Type	Orifice, Corner Taps	
,	Material	PVC	
,	Beta Ratio @ 68.0 Deg F	0.2925	d/D
,	Bore @ 68.0 Deg F	0.3068	d, Inch
Pipe.......,	Schedule STD and Size	1.0000	Inch
,	Material	PVC	
,	Inside Diameter @ 68.0 Deg F	1.0490	D, Inch
Base.......,	Pressure at Std Cond	14.6960	Pb, PSI Abs
,	Temperature at Std Cond	60.0000	Tb, Deg F
Local......,	Atmospheric Pressure	14.6960	Pg, PSI Abs
Pressure...,	Flowing at Upstream Tap	115.0000	Pf, PSI Gauge
,	Differential Maximum	18.0000	Hm, In WC
,	Differential Normal	0.1152	Hn, In WC
,	Permanent Loss @ Max Flow	15.8640	Lm, In WC d/P
,	Permanent Loss @ Norm Flow	0.1015	Ln, In WC
Temperature,	Flowing	120.0000	Tf, Deg F
Flow.......,	Maximum, Base Conditions	15.0000	Qm, Ft3/Min Flow
,	Normal, Base Conditions	1.2000	Qn, Ft3/Min
,	Reynolds Nmbr @ Norm Flow	1,692.4869	RDn
,	Reynolds Nmbr @ Max Flow	21,156.0859	RDm
Fluid Prop.,	Molecular Weight	28.9510	Mol. Wt.
,	Density @ Base Cond. (Est)	0.0764	Rhob, Lb/CFt
,	Density @ Flow Cond. (Est)	0.6057	Rhof, Lb/CFt
,	Viscosity @ Flowing	0.0196	Centipoise
,	Ratio of Specific Heats	1.4015	Cp/Cv
,	Compress Calc Method	Redlich Kwong	
,	Critical Pressure	547.3724	Pc, Psi abs
,	Critical Temperature	-221.2780	Tc, Deg F
,	Compressibility @ Base	0.9994	Zb
,	Compressibility @ Flowing	0.9976	Zf
Factors....,	Flow Coefficient	0.6143	C
,	Sizing Coefficient	0.0527	Sm
,	Gas Expansion Factor	1.0000	Y1
,	Combined Thermal Expan Factor	1.0000	Fa

This calculation performed in accordance with equation 9.107 U.S. Units or equation 9.121, S.I. units.

Warnings..., Outside recommended pipe id of 2-36 inches (50-900 mm).
, Outside recommended Reynolds No range of 10,000 - 10,000,000.

ONC #2
3" SCH 40

LAMBDA SQUARE, INC.
LSI FLOW METERING
P.O. BOX 1119-M - BAY SHORE, NY 11706
(516) 587-1000 - FAX (516) 587-1011

ORIFICE2 (Ver 1.52) FLOW ELEMENT CALCULATION

Tag.....: AGRA/M&E SCH 40

Spec No.:	Date..........: 10/27/95 14:38
Line No.:	Equipment No..:
Customer:	Customer PO...:
Project#:	Shop Order....:
Revision:	Revised By....:
CalcType: Beta Ratio	Fluid State...: Gas

Calculation Equ Ref: Flow Measurement Engr Handbook, 2nd Ed.

Fluid AIR

Element....,	Type	Orifice, Corner Taps	
,	Material	PVC	
,	Beta Ratio @ 68.0 Deg F	0.7609	d/D
,	Bore @ 68.0 Deg F	2.3344	d, Inch
Pipe.......,	Schedule STD and Size	3.0000	Inch
,	Material	PVC	
,	Inside Diameter @ 68.0 Deg F	3.0680	D, Inch
Base.......,	Pressure at Std Cond	14.6960	Pb, PSI Abs
,	Temperature at Std Cond	60.0000	Tb, Deg F
Local......,	Atmospheric Pressure	14.6960	Pg, PSI Abs
Pressure...,	Flowing at Upstream Tap	-10.0000	Pf, In Hg Gauge
,	Differential Maximum	18.0000	Hm, In WC
,	Differential Normal	0.1250	Hn, In WC d/P
,	Permanent Loss @ Max Flow	8.0254	Lm, In WC
,	Permanent Loss @ Norm Flow	0.0557	Ln, In WC
Temperature,	Flowing	120.0000	Tf, Deg F
Flow.......,	Maximum, Base Conditions	300.0000	Qm, Ft3/Min Flow
,	Normal, Base Conditions	25.0000	Qn, Ft3/Min
,	Reynolds Nmbr @ Norm Flow	12,056.0268	RDn
,	Reynolds Nmbr @ Max Flow	144,672.3218	RDm
Fluid Prop.,	Molecular Weight	28.9510	Mol. Wt.
,	Density @ Base Cond. (Est)	0.0764	Rhob, Lb/CFt
,	Density @ Flow Cond. (Est)	0.0456	Rhof, Lb/CFt
,	Viscosity @ Flowing	0.0196	Centipoise
,	Ratio of Specific Heats	1.4015	Cp/Cv
,	Compress Calc Method	Redlich Kwong	
,	Critical Pressure	547.3724	Pc, Psi abs
,	Critical Temperature	-221.2780	Tc, Deg F
,	Compressibility @ Base	0.9994	Zb
,	Compressibility @ Flowing	0.9998	Zf
Factors....,	Flow Coefficient	0.6331	C
,	Sizing Coefficient	0.4494	Sm
,	Gas Expansion Factor	0.9998	Y1
,	Combined Thermal Expan Factor	1.0000	Fa

This calculation performed in accordance with equation 9.107 U.S. Units or equation 9.121, S.I. units.
Warnings..., Outside recommended beta ratio range of 0.2 - 0.75.

(MC #3)

3" SCH 80

LAMBDA SQUARE, INC.
LSI FLOW METERING
P.O. BOX 1119-M - BAY SHORE, NY 11706
(516) 587-1000 - FAX (516) 587-1011

ORIFICE2 (Ver 1.52) FLOW ELEMENT CALCULATION

Tag.....: AGRA/M&E SCH 80
Spec No.: Date..........: 10/27/95 14:39
Line No.: Equipment No..:
Customer: Customer PO...:
Project#: Shop Order....:
Revision: Revised By....:
CalcType: Beta Ratio Fluid State...: Gas
Calculation Equ Ref: Flow Measurement Engr Handbook, 2nd Ed.

Fluid AIR

Element....,	Type	Orifice, Corner Taps	
,	Material	PVC	
,	Beta Ratio @ 68.0 Deg F	0.7902	d/D
,	Bore @ 68.0 Deg F	2.2915	d, Inch
Pipe.......,	Schedule 80 and Size	3.0000	Inch
,	Material	PVC	
,	Inside Diameter @ 68.0 Deg F	2.9000	D, Inch
Base.......,	Pressure at Std Cond	14.6960	Pb, PSI Abs
,	Temperature at Std Cond	60.0000	Tb, Deg F
Local......,	Atmospheric Pressure	14.6960	Pg, PSI Abs
Pressure...,	Flowing at Upstream Tap	-10.0000	Pf, In Hg Gauge
,	Differential Maximum	18.0000	Hm, In WC
,	Differential Normal	0.1250	Hn, In WC
,	Permanent Loss @ Max Flow	7.3212	Lm, In WC
,	Permanent Loss @ Norm Flow	0.0508	Ln, In WC
Temperature,	Flowing	120.0000	Tf, Deg F
Flow.......,	Maximum, Base Conditions	300.0000	Qm, Ft3/Min
,	Normal, Base Conditions	25.0000	Qn, Ft3/Min
,	Reynolds Nmbr @ Norm Flow	12,754.4449	RDn
,	Reynolds Nmbr @ Max Flow	153,053.3390	RDm
Fluid Prop.,	Molecular Weight	28.9510	Mol. Wt.
,	Density @ Base Cond. (Est)	0.0764	Rhob, Lb/CFt
,	Density @ Flow Cond. (Est)	0.0456	Rhof, Lb/CFt
,	Viscosity @ Flowing	0.0196	Centipoise
,	Ratio of Specific Heats	1.4015	Cp/Cv
,	Compress Calc Method	Redlich Kwong	
,	Critical Pressure	547.3724	Pc, Psi abs
,	Critical Temperature	-221.2780	Tc, Deg F
,	Compressibility @ Base	0.9994	Zb
,	Compressibility @ Flowing	0.9998	Zf
Factors....,	Flow Coefficient	0.6294	C
,	Sizing Coefficient	0.5030	Sm
,	Gas Expansion Factor	0.9998	Y1
,	Combined Thermal Expan Factor	1.0000	Fa

d/p

Flow

This calculation performed in accordance with equation 9.107 U.S. Units or equation 9.121, S.I. units.
Warnings..., Outside recommended beta ratio range of 0.2 - 0.75.

APPENDIX D

DRAFT SOIL VAPOR EXTRACTION TREATMENT SYSTEM AND EXTRACTION/MONITORING WELL FIELD SAMPLING PLAN (FSP) AND QUALITY ASSURANCE PROJECT PLAN (QAPP)

Table 3-1
List of Container Type, Required Sample Preservative and Maximum Holding Time

Matrix	Container Type	Parameters	Preservative	Holding Time
Soil Vapor - Routine Monitoring	Tedlar bag	Total VOCs	Light tight container	24 hours
Soil Vapor - Rebound Monitoring[a]	Tedlar bag	Indicator VOCs	Light tight container	24 hours
Soil Vapor - Rebound Monitoring	Summa canister	VOCs	None	14 days
Water - SVE Treatment System Stack Sump	40 ml VOA vial	VOCs[c]	4° C HCL to pH < 2	14 days, unpreserved 7 days

NOTES:

a. Field laboratory GC analysis - Direct inject or field PID
b. CLP - Laboratory analysis - TO-14
c. PCE, TCE, 1,1-DCE and 1,1,1-TCA

the sample bag is filled, the sample inlet line is turned off between the source and the sample bag, the vacuum release valve on the vacuum box is opened, and the valve on the sample bag is closed, ending the sampling event. All tubing connections utilize stainless steel swage-lok fittings and new, 1/4-inch Teflon tubing. All used segments of Teflon tubing are replaced with new segments following each sampling event.

4.3 SOIL VAPOR SAMPLING - (FIELD MONITORING)

This section describes the methodologies that will be employed to collect soil vapor samples from the SVE system for routine monitoring and for evaluation of when to commence rebound sampling.

4.3.1 Pre-sample Purging

Prior to collecting samples, all soil vapor sampling locations are initially purged of static air residing in the sampling system. Drawing 96-M-5, Detail 6, Appendix A provides sampling locations on SVE extraction wells, and Drawings 96-E-2 and 96-E-3, Appendix A provide sampling locations on the SVE treatment systems. In the case of SVE extraction and monitoring wells that have been switched off, static air is calculated as the open area of the targeted well.

The formula used to quantify this volume is as follows:

$$V = \Pi r^2 h$$

Where:

- V = Volume of well (cm^3)
- Π = 3.1416 (unitless)
- r = radius of well (cm)
- h = height of well (cm)

4.4 SOIL VAPOR SAMPLING FOR REBOUND (LABORATORY ANALYSIS)

This section describes the methodologies that will be employed to conduct periodic rebound monitoring on SVE monitoring cluster wells for CLP laboratory analysis and subsequent VLEACH and Mixing Cell Screening.

4.4.1 Presample Purging

Prior to collecting samples, all SVE operable unit monitoring well locations are initially purged of static air residing in the sampling system. Drawing 96-M-2, Detail 11, Appendix A provides sampling locations on SVE extraction wells, and Drawings 96-E-2 and 96-E-3, Appendix A provide sampling locations on the SVE treatment systems. The static air volume is calculated as the open area of the targeted well. The formula used to quantify this volume is as follows:

$$V = \Pi r^2 h$$

Where:

V	=	Volume of well (cm^3)
Π	=	3.1416 (unitless)
r	=	radius of well (cm)
h	=	height of well (cm)

The sampling methodology for SVE wells that have been switched off consists of initially purging two well volumes using the programmable vacuum pump or until peak VOC concentrations occur, whichever comes first. During purging, VOC concentrations are continuously monitored and recorded using a photoionization detector (Photovac Microtip 200, or equivalent) positioned at the exhaust port on the purge pump.

4.4.2 Rebound Soil Vapor Sample Collection (Laboratory Analysis)

Following the purging protocol described in the previous section, the sampling location is allowed to return to its ambient pressure reading (pressure prior to pumping). At this time, the programmable mass controlled vacuum pump will be disconnected from the sample line and replaced with a pre-evacuated, stainless steel SUMMA canister. Figure 4-3 illustrates the sampling schematic for rebound soil vapor sample collection. To initiate sampling, the downstream end of the Teflon tubing will be attached to the intake of the field-calibrated mass flow controller mounted to the SUMMA canister (see Figure 4-3). After ensuring that all fittings are gas tight, the needle valve on the SUMMA canister will be opened to begin sample collection. Total sampling time will be 15 to 30 minutes which is sufficient duration to collect 3 to 6 liters of soil gas at a controlled flow rate of 200 ml/min. All used segments of Teflon tubing will be replaced with new segments following sampling.

4.5 DECONTAMINATION OF EQUIPMENT

Prior to each use and reuse all stainless steel mass flow controllers and swage-lok fittings will be purged with clean air for at least thirty minutes. Nitrile or latex surgical gloves are worn during handling and assembly of the sampling apparatus.

6.0 SVE TREATMENT SYSTEM STACK SUMP

This section describes the sampling and analytical methodology for monitoring the SVE treatment stack sump liquids.

6.1 STACK SUMP SAMPLING

The sampling location for accessing the SVE treatment stack sump valve is illustrated on Drawing 96-E-3, Appendix A. The stack sump is positioned below the SVE treatment stack. A valve is positioned at the terminus of a one-inch diameter steel line running from below the sump. Periodically, the valve will be opened to inventory and record the presence of liquids in the line. If deemed appropriate, sampling will be carried out by filling 40 milliliter capacity VOA septum vials (2 quantity) from the drain line valve. The samples will be appropriately labeled, preserved, packaged and submitted to a CCP laboratory for VOC analysis. See Table 3-1 and Section 3 of this Appendix.

APPENDIX F

DRAFT EMERGENCY CONTINGENCY PLAN

CONTINGENCY PLAN

1.0 INTRODUCTION

The Contingency Plan for the Phoenix-Goodyear Airport Soil Vapor Extraction (SVE) operable unit is prepared to protect local communities both residential and commercial in the event that an accident or an emergency should occur.

Due to the nature and design of the SVE operable unit, the Contingency Plan primarily deals with the facility personnel which directly interface with the SVE operable unit. Compliance points for SVE operable unit Contingency Plan monitoring will include air monitoring program and a spill control and countermeasures plan.

A brief description of the subsurface conditions present at the Phoenix-Goodyear Airport are presented as an overview of the required site treatment. A general description for the operable unit is also presented as a primer for the Contingency Plan terminology.

1.1 Subsurface Conditions

Past uses of the Phoenix-Goodyear Airport including maintenance and manufacturing utilized various solvents and cleaning agents as degreasers in the manufacturing and maintenance process. Use of the solvents and cleaning agents throughout the facility resulted in the solvents and cleaning agents being released to the site soils. Infiltration of surface and rainwater into the site soils following the release of the solvents and cleaning agents resulted in downward migration of the solvents to the groundwater table.

Due to the solvent migration, both the soil and groundwater in areas of the site contain levels of solvent contamination that exceed the U.S. EPA maximum contaminant levels. Concentrations of soil vapor in the soil range between 50 μg/L to as high as 9,600 μg/L. Groundwater concentrations range from 5 μg/L (ppbV) to 2,000 μg/L (ppbV). As a result of the soil and groundwater concentrations exceeding the maximum contaminant levels, a remediation program was instituted to remove the contaminants, where required using groundwater and soil vapor extraction. The scope of this Contingency Plan covers the soil vapor extraction (SVE) operable unit. The groundwater extraction operable unit is covered in a separate Contingency Plan under a separate cover.

1.2 SVE Operable Unit

The soil vapor extraction operable unit is designed to remove the residual solvents in the soil in the vapor phase. The process is based on the principle that the solvents have a high vapor pressure and will volatilize from the liquid to the vapor phase under the proper thermodynamic conditions. The soil vapor extraction produces the proper conditions in the soil to promote the volatilization process and remove the solvents in the vapor phase.

The soil vapor extraction system in principle places a vacuum on the soil through a network of wells screened in the solvent-contaminated soil. The wells are connected to a vacuum blower which induces a vacuum on the network of wells and draws the solvent vapors out. As the solvent vapors are drawn out, liquid solvent in the soil volatilizes into the vapor phase and are then removed. Figure F-1 illustrates the configuration of the SVE wells.

Once the solvent vapors have been extracted, they must be removed from the vapor stream prior to discharge to the atmosphere. The solvent vapors are removed from the air stream through granular activated carbon (GAC) beds. Figures F-2, F-3, and F-4 illustrate the configuration of the SVE operable unit and the individual components.

The solvent-laden air passes through the GAC beds and the solvents are removed. Prior to the solvent-laden air passing through the GAC beds, any entrained water is required to be removed. The water is removed from the solvent-laden air in the air/water separator and is held in the air/water separator reservoir (150-gallon capacity) until a set limit has been reached. At this point, a switch automatically starts a water transfer pump (P-1) which evacuates the water into a 240-gallon water storage tank. A high level water switch in the water storage tank prevents

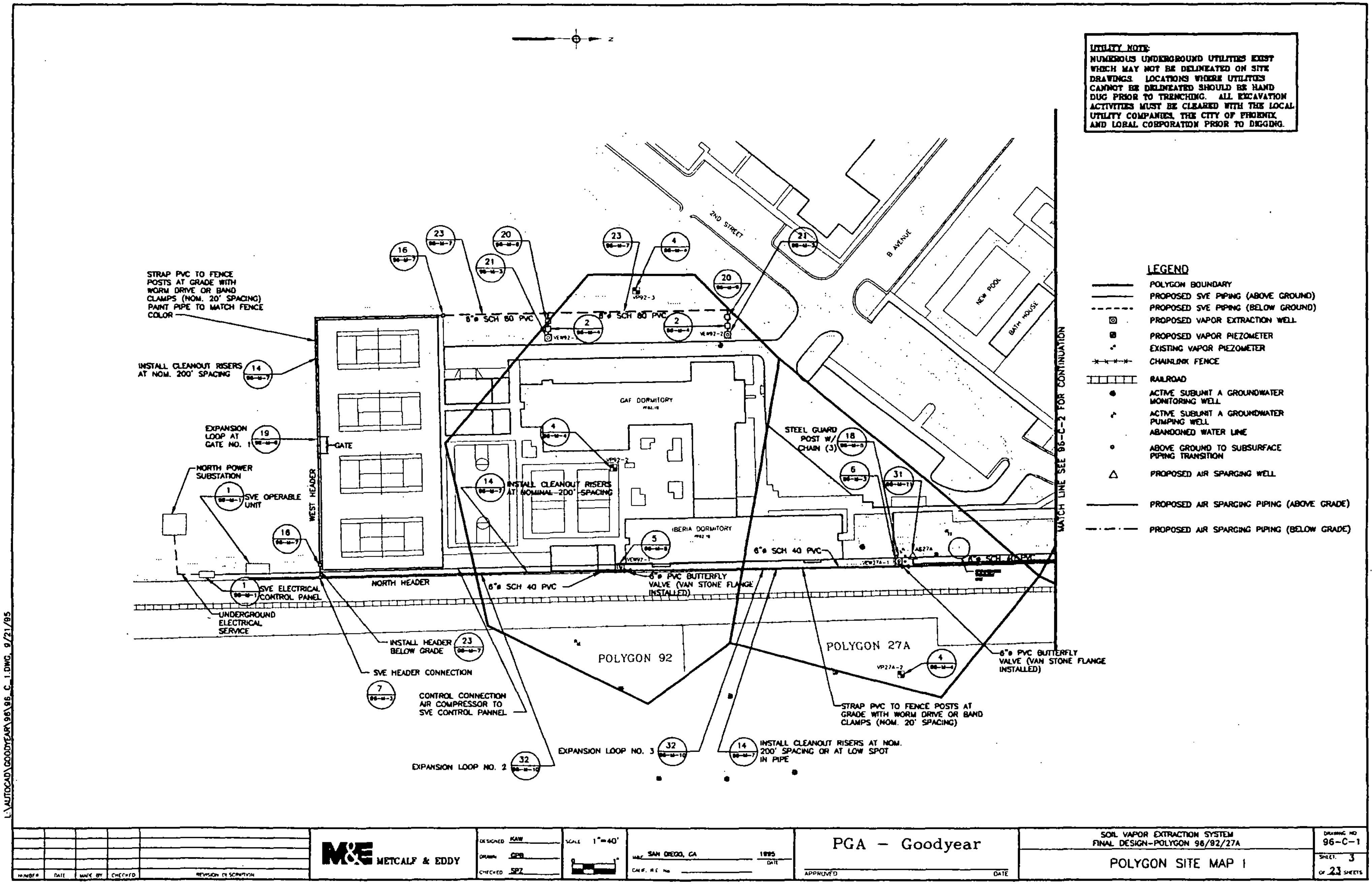

UTILITY NOTE:
NUMEROUS UNDERGROUND UTILITIES EXIST WHICH MAY NOT BE DELINEATED ON SITE DRAWINGS. LOCATIONS WHERE UTILITIES CANNOT BE DELINEATED SHOULD BE HAND DUG PRIOR TO TRENCHING. ALL EXCAVATION ACTIVITIES MUST BE CLEARED WITH THE LOCAL UTILITY COMPANIES, THE CITY OF PHOENIX, AND LORAL CORPORATION PRIOR TO DIGGING.
LEGEND
POLYGON BOUNDARY
PROPOSED SVE PIPING (ABOVE GROUND)
PROPOSED SVE PIPING (BELOW GROUND)
PROPOSED VAPOR EXTRACTION WELL
PROPOSED VAPOR PIEZOMETER
EXISTING VAPOR PIEZOMETER
CHAINLINK FENCE
RAILROAD
ACTIVE SUBUNIT A GROUNDWATER MONITORING WELL
ACTIVE SUBUNIT A GROUNDWATER PUMPING WELL
ABANDONED WATER LINE
ABOVE GROUND TO SUBSURFACE PIPING TRANSITION
PROPOSED AIR SPARGING WELL
PROPOSED AIR SPARGING PIPING (ABOVE GRADE)
PROPOSED AIR SPARGING PIPING (BELOW GRADE)
MATCH LINE SEE 96-C-2 FOR CONTINUATION
2ND STREET
B AVENUE
NEW POOL
BATH HOUSE
GAF DORMITORY
IBERIA DORMITORY
POLYGON 92
POLYGON 27A
STRAP PVC TO FENCE POSTS AT GRADE WITH WORM DRIVE OR BAND CLAMPS (NOM. 20' SPACING) PAINT PIPE TO MATCH FENCE COLOR
INSTALL CLEANOUT RISERS AT NOM. 200' SPACING
EXPANSION LOOP AT GATE NO. 1
GATE
NORTH POWER SUBSTATION
SVE OPERABLE UNIT
WEST HEADER
NORTH HEADER
SVE ELECTRICAL CONTROL PANEL
UNDERGROUND ELECTRICAL SERVICE
6"ø SCH 80 PVC
6"ø SCH 40 PVC
INSTALL CLEANOUT RISERS AT NOMINAL 200' SPACING
6"ø PVC BUTTERFLY VALVE (VAN STONE FLANGE INSTALLED)
STEEL GUARD POST W/ CHAIN (3)
INSTALL HEADER BELOW GRADE
SVE HEADER CONNECTION
CONTROL CONNECTION AIR COMPRESSOR TO SVE CONTROL PANNEL
EXPANSION LOOP NO. 2
EXPANSION LOOP NO. 3
INSTALL CLEANOUT RISERS AT NOM. 200' SPACING OR AT LOW SPOT IN PIPE
STRAP PVC TO FENCE POSTS AT GRADE WITH WORM DRIVE OR BAND CLAMPS (NOM. 20' SPACING)
VP92-3
VEW92-1
VEW92-2
VP92-2
VEW97-1
VEW27A-1
AS27A
VP27A-2
L:\AUTOCAD\GOODYEAR\96\96_C_1.DWG 9/21/95
M&E METCALF & EDDY
DESIGNED KAW
DRAWN GPB
CHECKED SPZ
SCALE 1"=40'
SAN DIEGO, CA
1995
PGA - Goodyear
APPROVED
DATE
SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN-POLYGON 96/92/27A
POLYGON SITE MAP 1
DRAWING NO 96-C-1
SHEET 3
OF 23 SHEETS

Figure F-1

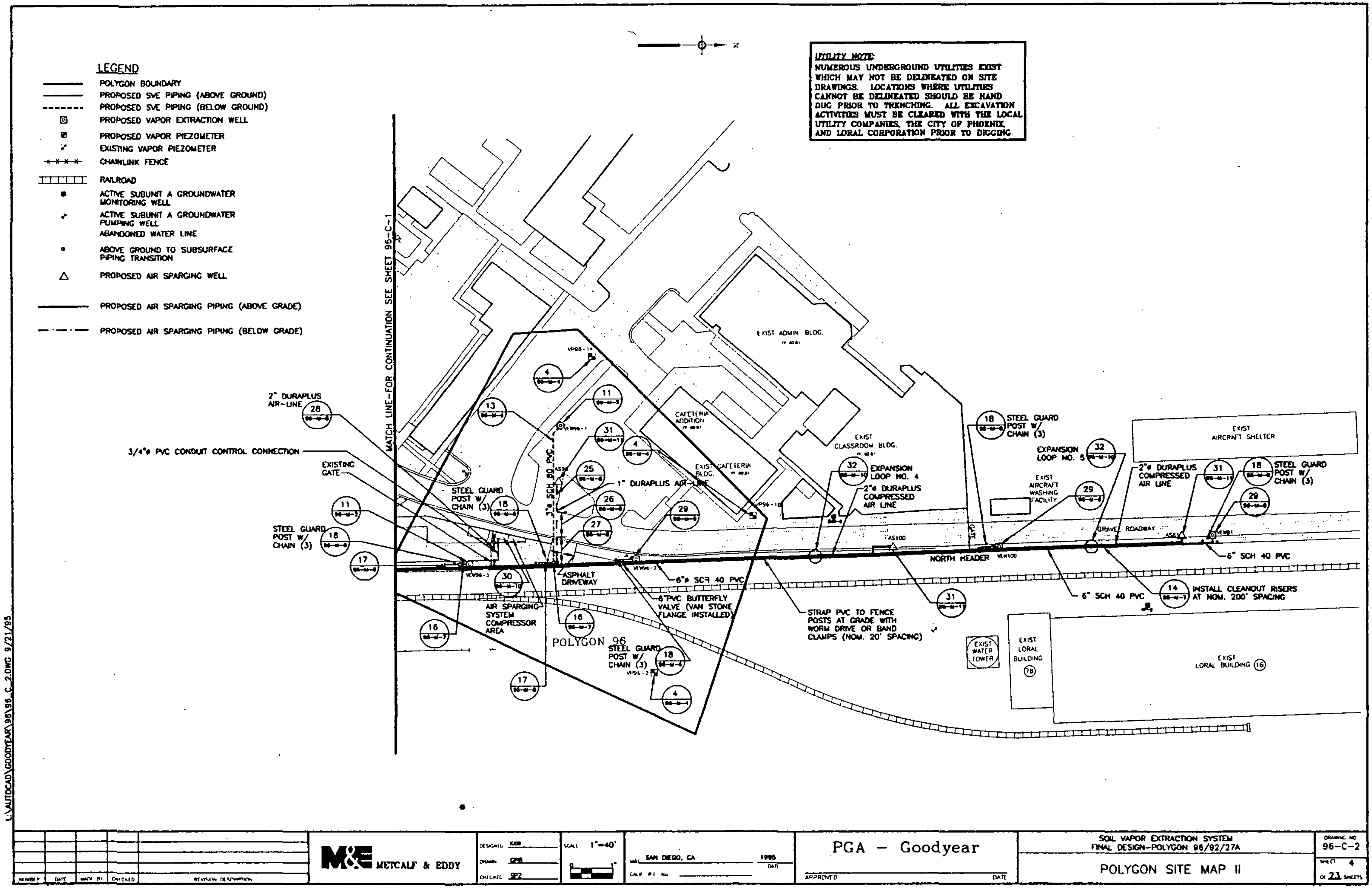
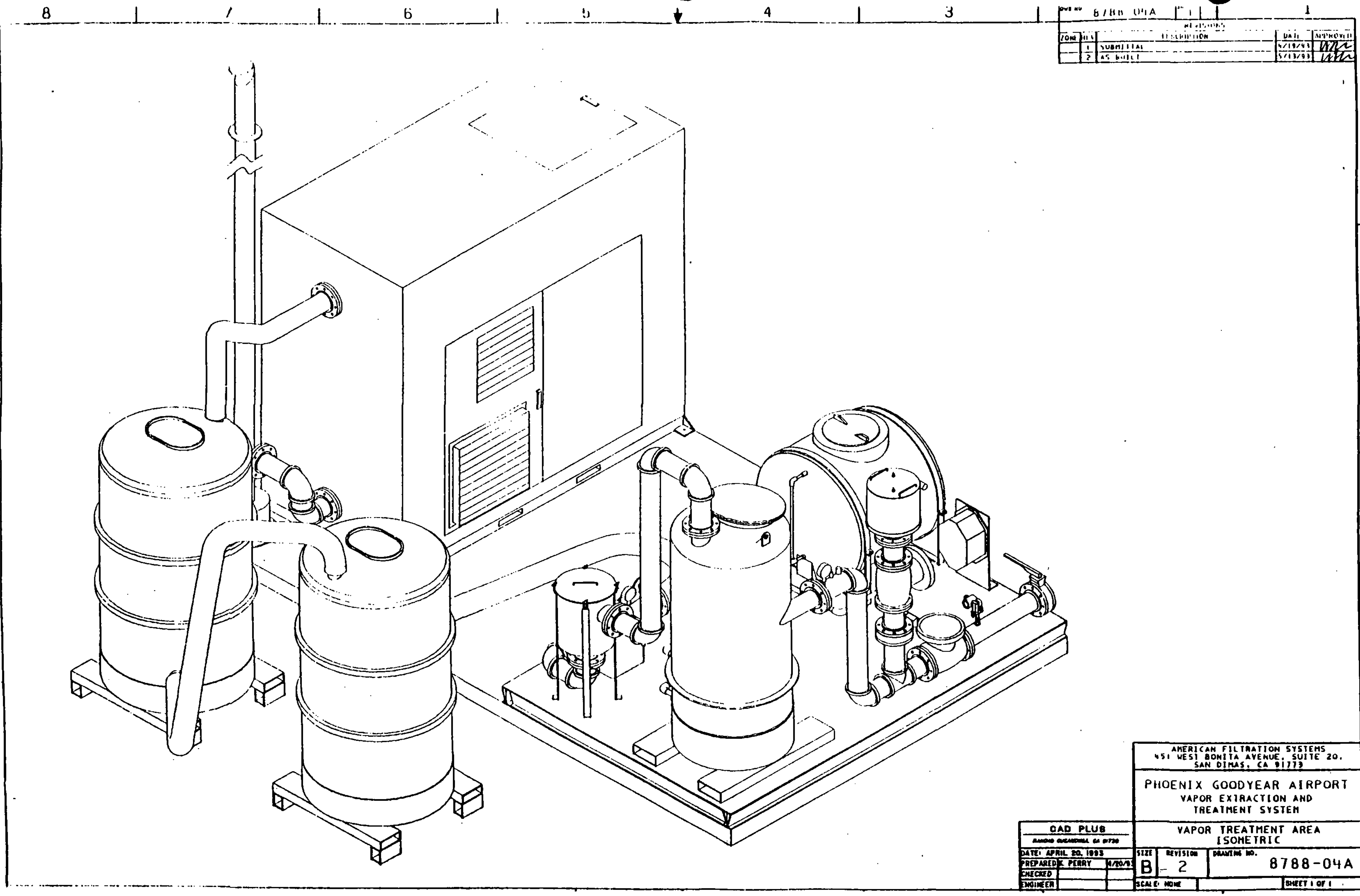
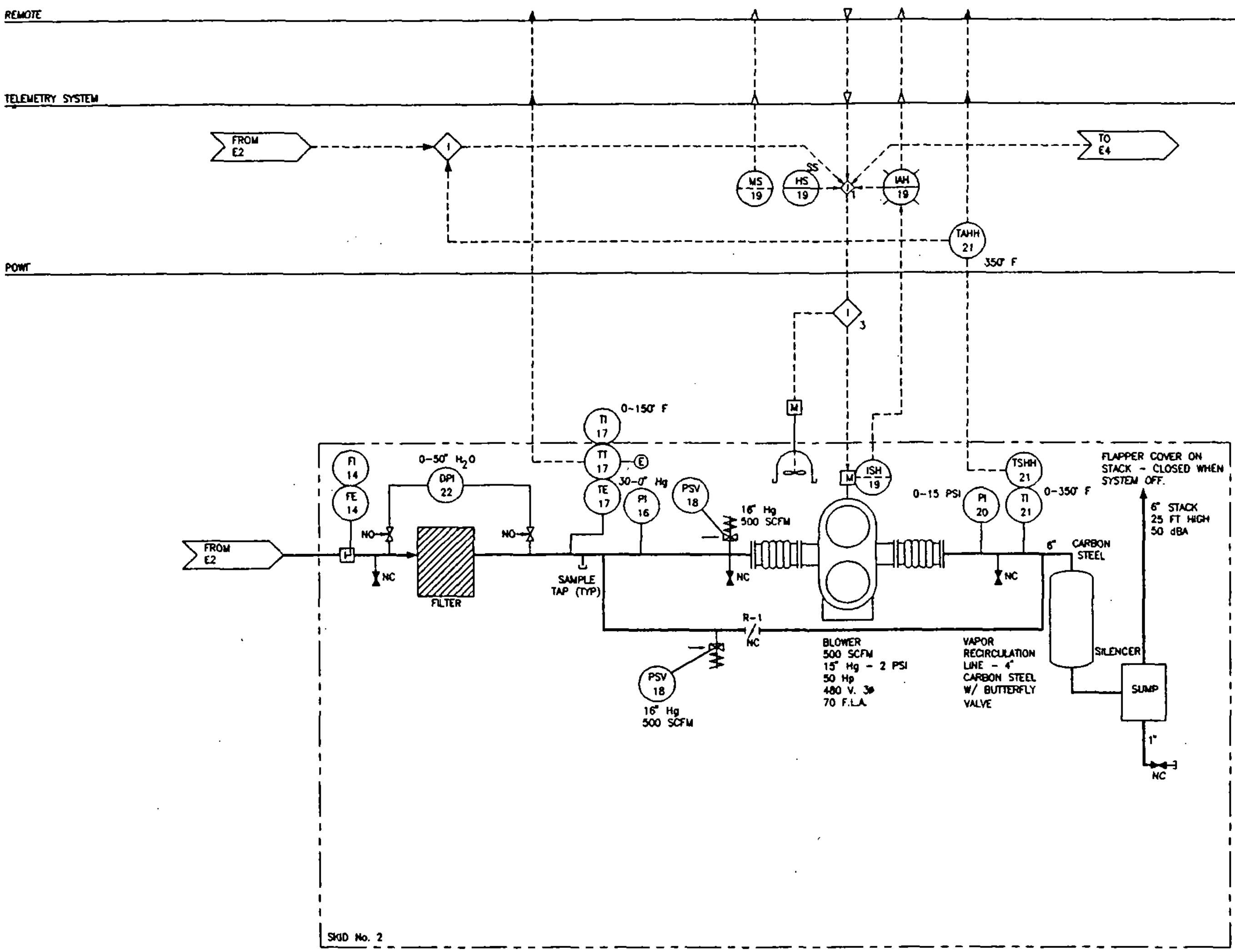


Figure E-1 (Continued)



8
7
6
5
4
3
1
DWG NO 8788-04A
REVISIONS
ZONE
REV
DESCRIPTION
DATE
APPROVED
1 SUBMITTAL 4/19/93
2 AS BUILT 5/13/93
AMERICAN FILTRATION SYSTEMS
451 WEST BONITA AVENUE, SUITE 20,
SAN DIMAS, CA 91773
PHOENIX GOODYEAR AIRPORT
VAPOR EXTRACTION AND
TREATMENT SYSTEM
CAD PLUS
VAPOR TREATMENT AREA
ISOMETRIC
DATE: APRIL 20, 1993
PREPARED K. PERRY 4/20/93
CHECKED
ENGINEER
SIZE B
REVISION 2
DRAWING NO. 8788-04A
SCALE: NONE
SHEET 1 OF 1

Figure F-2



INTERLOCK NOTES:

1. LOCK OUT BLOWER WITH MANUAL RESET ON LOW FLOW FROM WELLS, HIGH-HIGH LEVEL IN AIR/WATER SEPARATOR, HIGH-HIGH LEVEL IN CONDENSED LIQUID TANK, BLOWER OVERLOAD, OR BY TELEMETRY
2. START CONDENSATE TRANSFER PUMP ON HIGH LEVEL IN AIR/WATER SEPARATOR, STOP PUMP ON LOW LEVEL IN AIR/WATER SEPARATOR
3. BLOWER CONTROL PANEL EXHAUST FAN TO START AND STOP AT THE SAME TIME AS BLOWER.

NOTE: ALL COMPONENTS SHOWN WITH EXCEPTION OF STACK AND SUMP MOUNTED ON CARBON STEEL BOX-TUBE SKID W/FORKLIFT OR CRANE LIFTING POINTS

C:\GOODYEAR\96\96_E_3.DWG, 9/21/95

NUMBER	DATE	MADE BY	CHECKED	REVISION DESCRIPTION
1	3-22-93	[illegible]		ELEC. PER MFG. CHANGE
2	10-26-93	[illegible]		CHANGES FOR RECORD DRAWING
3	2-94	SZ		POLYGON 84 DESIGN

M&E METCALF & EDDY

DESIGNED ______
DRAWN ______
CHECKED ______

SCALE: NONE

SAN DIEGO, CA — 1994 DATE
CALIF. R.E. No. ______

PGA – Goodyear

APPROVED ______ DATE

SOIL VAPOR EXTRACTION SYSTEM
FINAL DESIGN – POLYGON 96/92/27A
PROCESS & INSTRUMENTATION DIAGRAM 2

DRAWING NO: 96-E-3
SHEET: 18
OF 23 SHEETS

Figure F-3

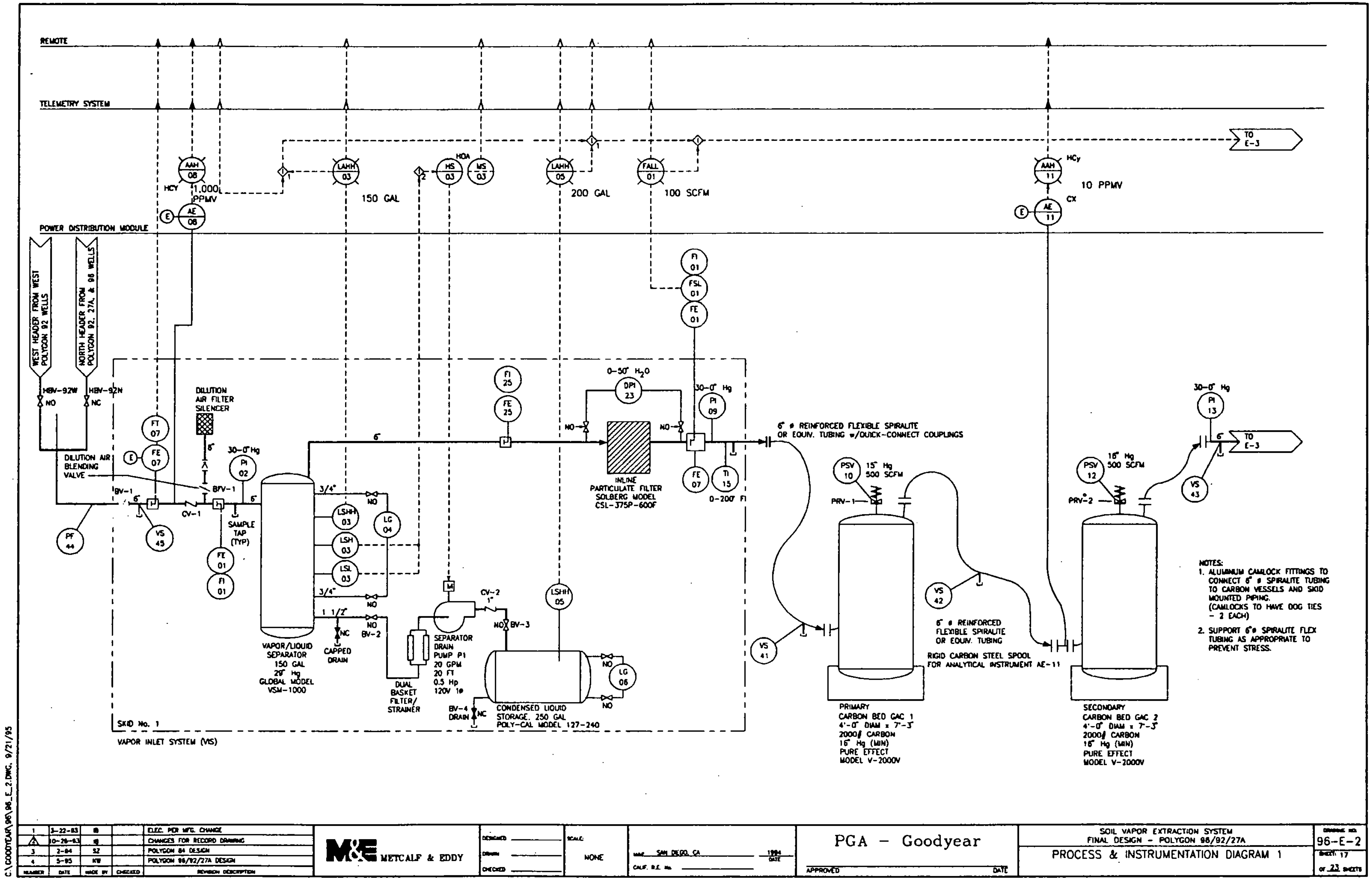

REMOTE
TELEMETRY SYSTEM
POWER DISTRIBUTION MODULE
WEST HEADER FROM WEST POLYGON 92 WELLS
NORTH HEADER FROM POLYGON 92, 27A, & 96 WELLS
HBV-92W NO
HBV-92N NC
AAH 08
HCY 1,000 PPMV
AE 08
LAHH 03
150 GAL
HOA
HS 03
MS 03
LAHH 05
200 GAL
FALL 01
100 SCFM
AAH 11
HCy
10 PPMV
CX
AE 11
TO E-3
FI 01
FSL 01
FE 01
DILUTION AIR FILTER SILENCER
DILUTION AIR BLENDING VALVE
FT 07
FE 07
BV-1
CV-1
BFV-1
30-0" Hg
PI 02
SAMPLE TAP (TYP)
PF 44
VS 45
FE 01
FI 01
VAPOR/LIQUID SEPARATOR 150 GAL 29" Hg GLOBAL MODEL VSM-1000
LSHH 03
LSH 03
LSL 03
LG 04
CAPPED DRAIN
BV-2
DUAL BASKET FILTER/ STRAINER
SEPARATOR DRAIN PUMP P1 20 GPM 20 FT 0.5 Hp 120V 1ø
CV-2
BV-3
BV-4 DRAIN
LSHH 05
CONDENSED LIQUID STORAGE, 250 GAL POLY-CAL MODEL 127-240
LG 06
FI 25
FE 25
0-50" H_2O
DPI 23
INLINE PARTICULATE FILTER SOLBERG MODEL CSL-375P-600F
30-0" Hg
PI 09
FE 07
TI 15
0-200° F
6" ø REINFORCED FLEXIBLE SPIRALITE OR EQUIV. TUBING w/QUICK-CONNECT COUPLINGS
PSV 10
15" Hg 500 SCFM
PRV-1
VS 41
VS 42
6" ø REINFORCED FLEXIBLE SPIRALITE OR EQUIV. TUBING
RIGID CARBON STEEL SPOOL FOR ANALYTICAL INSTRUMENT AE-11
PRIMARY CARBON BED GAC 1 4'-0" DIAM x 7'-3" 2000# CARBON 16" Hg (MIN) PURE EFFECT MODEL V-2000V
PSV 12
16" Hg 500 SCFM
PRV-2
SECONDARY CARBON BED GAC 2 4'-0" DIAM x 7'-3" 2000# CARBON 16" Hg (MIN) PURE EFFECT MODEL V-2000V
30-0" Hg
PI 13
VS 43
TO E-3
NOTES:
1. ALUMINUM CAMLOCK FITTINGS TO CONNECT 6" ø SPIRALITE TUBING TO CARBON VESSELS AND SKID MOUNTED PIPING. (CAMLOCKS TO HAVE DOG TIES - 2 EACH)
2. SUPPORT 6" ø SPIRALITE FLEX TUBING AS APPROPRIATE TO PREVENT STRESS.
SKID No. 1
VAPOR INLET SYSTEM (VIS)
C:\GOODYEAR\96\96_E_2.DWG, 9/21/95
1 | 3-22-93 | ELEC. PER MFG. CHANGE
2 | 10-26-93 | CHANGES FOR RECORD DRAWING
3 | 2-94 | SZ | POLYGON 84 DESIGN
4 | 5-95 | KW | POLYGON 96/92/27A DESIGN
NUMBER | DATE | MADE BY | CHECKED | REVISION DESCRIPTION
M&E METCALF & EDDY
DESIGNED
DRAWN
CHECKED
SCALE: NONE
SAN DIEGO, CA 1994
CALIF. R.E. No.
PGA - Goodyear
APPROVED DATE
SOIL VAPOR EXTRACTION SYSTEM FINAL DESIGN - POLYGON 96/92/27A
PROCESS & INSTRUMENTATION DIAGRAM 1
DRAWING NO. 96-E-2
SHEET 17 OF 23 SHEETS

Figure F-4

tank over filling. This tank and the air/water separator are the only vessels containing liquids that could be spilled or released to the environment. The water contained in these vessels will be primarily from condensation in the SVE subsurface piping and could contain trace amounts of solvent. Based on previous experience with similar projects, it is anticipated that this water will not exceed greater 50 μg/L total solvents, therefore, it would not be considered an emergency hazard. When the water storage tank is full, it will be transferred via vacuum truck or similar equipment to the Subunit A groundwater treatment system for treatment.

After the solvent-laden vapors pass through the GAC and the solvents are removed, the air then passes through the vacuum blower and is exhausted to the atmosphere via the discharge stack. The entire extraction and treatment system with the exception of the discharge stack and its related piping is under vacuum, resulting in a fail-safe system design with respect to fugitive emissions. Any leaks in the system piping will result in ambient air being drawn into the system rather that solvent-laden air being exhausted to the atmosphere. All piping under positive system pressure has had the solvent vapors removed.

The only opportunity for discharge of solvent-laden air to the atmosphere is if the GAC units are expended and the solvents are not removed. This scenario is minimized through the installation of a continuous on-line solvent vapor monitor in the discharge of the primary GAC bed. Detectable levels of solvents in the air effluent from the primary GAC bed will result in system shut-down and GAC regeneration and/or changeout. The Maricopa County discharge regulations were used to set this limit at 10 ppmV as TCE.

As an added precaution against solvent breakthrough of the GAC and discharge to the atmosphere, a secondary GAC bed has been installed in series with the primary GAC. Should the primary GAC breakthrough, the secondary GAC, the same size as the primary, will assure that the treatment system remains within the permitted discharge allowances. Upon carbon changeout, the secondary GAC will be used as the primary GAC, thus enabling the fresh GAC to provide solvent discharge protection in the event of primary GAC breakthrough. Lastly, the entire treatment system is connected directly to a telemetry unit and emergency autodialer which can be accessed by M&E computers at any time of the day or night via telephone lines. In the event of an alarm condition, the telemetry will automatically dial the Emergency Response Parties to alert them of the condition and will record the condition of the emergency.

The following sections of this Contingency Plan highlight the personnel and actions necessary to protect populations around the SVE operable unit when in operation.

2.0 EMERGENCY RESPONSE PARTY

The SVE operable unit has been designed with safety as a primary concern. In the event that an emergency condition arises, the system telemetry unit will automatically dial the Emergency Response Parties for prompt response. Two parties have been listed to respond to system emergencies. The first party is for immediate response to evaluate the condition of the system emergency and determine if the system engineers are required to respond. Response time for the first party during standard working hours is less than two hours. All conditions at the time of the emergency until on-site response will be recorded by the system telemetry unit.

The second response party is the system engineers, or Metcalf & Eddy, Inc. M&E will respond to the system condition within 24 hours of the emergency condition if deemed necessary by consultation between the first response party and M&E.

2.1 First Response Party

Bartholomew Engineering
4120 N. 20th Street
Phoenix, Arizona 85016
(602) 957-0208 office
(602) 310-9176 pager
(602) 488-1860 home
(602) 978-3326 home
Mr. Richard Bartholomew

2.2 Second Response Party

Metcalf & Eddy, Inc.
701 B Street, Suite 1100
San Diego, California 92101
Scott P. Zachary
(619) 233-7855
(619) 229-0170 (home)
(800) 369-1207 (pager)

3.0 OVERSIGHT NOTIFICATION

Due to the type of system and fail-safe nature of operation, notification of federal, state, and local agencies is not anticipated. If a system emergency should require oversight notification, the following agencies will be notified within 24 hours of the emergency for response.

3.1 Local Site Representative

Lufthansa Airlines Training Center
Phoenix-Goodyear Airport
1658 So. Litchfield Road
Goodyear, Arizona 85338
Ms. Irmgard Bueschgen
(602) 932-1600

Loral Corporation
3200 S. Litchfield Road
Goodyear, Arizona 85338
Mr. Tom Heim/Mr. Randy Clark
(602) 925-7102/-7274

City of Phoenix
Office of Environmental Programs
200 W. Washington St., Floor 14
Phoenix, Arizona 85003
Mr. Don Stoltzfus
(602) 256-5669

3.2 State Site Representative

Arizona Department of Environmental Quality
3033 N. Central Avenue, 7th Floor
Phoenix, Arizona 85012
Ms. Nancy Moore
(602) 207-4180

3.3 Federal Site Representative

United States Environmental Protection Agency
401 M Street SW
Washington, DC 20460
Mr. Craig Cooper - 5203G
(703) 603-9100

3.4 Emergency Squad

City of Goodyear Fire Department
S. Litchfield Road
Goodyear, Arizona 85338
(602) 932-2300

American Ambulance
1401 E. Washington St.
Phoenix, Arizona
(602) 253-1492

Lifeflite Air Ambulance
(602) 985-2873

Good Samaritan Hospital
51st Street and Campbell Ave.
Phoenix, Arizona
(602) 239-2000

3.5 System Owner/Operator

Goodyear Tire & Rubber Company
1144 E. Market Street
Akron, Ohio 44316
Mr. Mark Whitmore
(216) 796-3863

Appendix G of the June 1, 1995 SVE Final Design document, the Health and Safety Plan, contains more complete information with respect to emergency numbers and directions for personnel health and safety.

4.0 FIRST AID/MEDICAL RESPONSE

Due to the nature of the SVE operable unit, it is anticipated that any need for medical response will be needed in the construction phase of the project. The hazards as well as the responses for accidents during the construction phase of the project are discussed in detail in the Health & Safety Plan of the June 1, 1995 SVE Final Design document (Appendix G). If an emergency should arise that requires first aid or medical attention, the following parties should be contacted or utilized.

4.1 First-Aid Trained Personnel

Scott P. Zachary, Metcalf & Eddy, Inc.
(619) 233-7855 (San Diego)

Joe Weidmann, Metcalf & Eddy, Inc.
(805) 962-2122

Randy Clark, Loral Corporation
(602) 925-7101 (Phoenix)

Richard Bartholomew, Bartholomew Engineering
(602) 957-0208 (Phoenix)

4.2 Medical Facilities

In the event that an emergency should arise dial 911 for assistance. Medical facilities are:

American Ambulance
1401 E. Washington St.
Phoenix, Arizona
(602) 253-1492

Lifeflite Air Ambulance
(602) 985-2873

Good Samaritan Hospital
51st Street and Campbell Ave.
Phoenix, Arizona
(602) 239-2000

4.3 Fire/Rescue/Emergency Response Teams

In the unlikely event that a fire or emergency should develop in or around the operable unit, **911** should be called in an immediate emergency. All other cases, the following response parties should be contacted for response as required.

City of Goodyear Fire Department
S. Litchfield Road
Goodyear, Arizona 85338
(602) 932-2300

Poison Control Center
Good Samaritan Hospital
(602) 253-3334 or (602) 239-2000

Explosives Unit
Phoenix Fire Department
(602) 262-6771

CHEMTREC Emergency Response
1-800-424-9300

EPA ERT Emergency Hotline
(201) 321-6660

5.0 AIR MONITORING PLAN

The Air Monitoring Plan for the treatment system consists of monitoring the area around the extraction and treatment operable unit with a hand-held vapor analyzer as outlined in detailed in the Health & Safety Plan (Appendix G of the June 1, 1995 SVE Final Design document).

Due to the nature of the operation of the extraction and treatment operable unit, failures in the piping or other components of the system would not result in releases of contaminants to the atmosphere, but rather will result in ambient air being drawn into the treatment system. As a result of this design, no fugitive emissions are expected to result which would require monitoring. The system will conform at all times during operations to the air discharge conditions of Maricopa County, and therefore, will not result in a personal exposure problem.

To demonstrate compliance with the conditions in the Air Discharge conditions of Maricopa County, M&E has installed a continuous on-line hydrocarbon vapor analyzer in the treatment system piping to assure that the discharge limits are being met. Refer to Appendix F, Draft System Construction/Operation Permits and for the Air Permit specifications and Appendix G (June 1, 1995 SVE Final Design), the Health & Safety Plan for the personal work space monitoring specifics.

Should the treatment system and safety controls fail, a concentration of 4 ppmV in the stack exhaust would trigger the Contingency Plan operations. This level is based on 50 percent of the Maricopa County risk-based discharge limit of 4 pounds of TCE discharge per day with the operable unit operating at 500 scfm. Because the concentrations in the site subsurface are low, and two GAC units operate in series to protect against unplanned emissions, this discharge level is not anticipated to be reached and should not trigger the Contingency Plan.

6.0 SPILL CONTROL AND COUNTERMEASURES PLAN

The soil vapor extraction operable unit is designed primarily as a vapor conveyance system. No hazardous liquids are handled directly by the operable unit and therefore does not require a formal Spill Control and Countermeasures Plan.

Operation of the system does however have the potential of generating small amounts of liquid in the form of condensate from the subsurface piping network. This entrained condensate liquid in the air stream is removed with the air/water separator. Once the water has been separated, it collects in the 150 gallon reservoir of the air/water separator. When the water in the reservoir reaches a set level, a pump (P-1) is activated that transfers the water in the reservoir to a 240-gallon storage tank. The air/water separator, water transfer pump, and the 250 gallon water storage tank is located on skid number 1. See Appendix A, Draft Plans and Specifications for the skid configuration.

It is anticipated that the water collected in the air/water separator will contain only trace levels of the solvent contaminants. Due to the non-hazardous nature of this water, spill containment around the air/water separator is not required. Should a leak in the system piping occur, the system will be immediately shut down and the leak will be repaired. Water stored or collected in the air/water separator and 240-gallon storage tank will be transferred via a suction pump to a vacuum truck or mobile trailer. the water, once transferred to the truck or trailer will be transported to the site Subunit A groundwater treatment system where it will be treated prior to discharge.

Spills or releases from the system will be minimized through the ongoing operable unit Operation and Maintenance Plan. All vessel and pump piping and fittings will be checked on a regular basis for integrity and tightness. Any fittings found to be loose will be tightened, and any fittings found to be sub-standard will be promptly replaced. In the event that a water release should occur, the following parties will respond to evaluate the need for additional emergency measures.

First Response Party:

Bartholomew Engineering
4120 N. 20th Street
Phoenix, Arizona 85016
(602) 957-0208
(602) 310-9176 (pager)
(602) 488-1860 (home)
(602) 978-3326 (home)
Mr. Richard Bartholomew

Second Response Party:

Metcalf & Eddy, Inc.
450 B Street, Suite 1900
San Diego, California 92101
Scott P. Zachary
(619) 233-7855
(619) 229-0170 (home)
(800) 369-1207 (pager)

In the event that a water release does occur, the water from the release will be tested to determine if any contaminants are present. If contaminants are present, any soils surrounding the operable unit in the immediate release area will be tested for the target contaminants. If soils at the surface are found to be impacted, they will be scraped off and placed in lined roll-off containers which will then be remediated through the use of the SVE operable unit. The roll-off containers will be properly labeled and stored adjacent to the Subunit A groundwater treatment system compound. Once the soils have been remediated to non-detect levels as determined by laboratory analysis, they will be disposed of in a location at the PGA facility that is agreeable to the U.S. EPA, the City of Phoenix, and Goodyear Tire and Rubber Company.

Due to the negligible to trace levels of contaminants expected to be present in the air/water separator condensate water, a local contractor will be used to excavate and move any soil if deemed necessary. Two potential contractors that could perform the work include:

AGRA Earth & Environmental
1870 W. Prince Road, Suite 64
Tucson, Arizona 85705
(520) 792-2779
Mr. Darrell Williams

Anderson Contracting Co., Inc.
11030 No. 21st Avenue
Phoenix, Arizona
(602) 943-7214
Mr. Harvey Anderson

Each of these contractors are OSHA certified for hazardous materials site operations and will conduct all work in compliance with the site Health & Safety Plan and all other pertinent sections of this report. All spill countermeasures work conducted on site will be overseen by Metcalf & Eddy, Inc., the Goodyear Tire and Rubber Company, and the U.S. EPA.

APPENDIX H

POLYGONS 96/92/27A VLEACH/MIXCELL

ARM RUN DATA

Polygon 96 Soil Gas Data

Total Soil Concentration Calculations from Soil Gas Data
Polygon 96, Jan/Feb-1993 Phase II Investgation

Sample #	Total Clx Conc (ppbV)	Total Clx Conc (ug/L)*	Total Clx Conc (ug/Kg)**
VS-VP96-13	31000	160.00	95.84
VS-VP96-26.5	210000	1100.00	658.90
VS-VP96-37.5	220000	1200.00	718.80
VS-VP96-50	150000	790.00	473.21
	611000	3250.00	1946.75

*Laboratory conversion from ppbV to ug/L
**Multiply ug/L concentration by 0.599 L/Kg (calculated Kgt based on revised soil physical data).

1,1-DCE Soil Concentration Calculations from Soil Gas Data
Polygon 96, Jan/Feb-1993 Phase II Investgation

Sample #	1,1-DCE Conc (ppbV)	1,1-DCE Conc (ug/L)*	1,1-DCE Conc (ug/Kg)**
VS-VP96-13	0	0.00	0.00
VS-VP96-26.5	0	0.00	0.00
VS-VP96-37.5	0	0.00	0.00
VS-VP96-50	0	0.00	0.00
	0.00	0.00	0.00

1,1,1-TCA Soil Concentration Calculations from Soil Gas Data
Polygon 96, Jan/Feb-1993 Phase II Investgation

Sample #	1,1,1-TCA Conc (ppbV)	1,1,1-TCA Conc (ug/L)*	1,1,1-TCA Conc (ug/Kg)**
VS-VP96-13	0.0	0.00	0.00
VS-VP96-26.5	0.0	0.00	0.00
VS-VP96-37.5	0.0	0.00	0.00
VS-VP96-50	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 96 Soil Gas Data

TCE Soil Concentration Calculations from Soil Gas Data
Polygon 96, Jan/Feb-1993 Phase II Investgation

Sample #	TCE Conc (ppbV)	TCE Conc (ug/L)*	TCE Conc (ug/Kg)**
VS-VP96-13	31,000	160.00	95.84
VS-VP96-26.5	210,000	1100.00	658.90
VS-VP96-37.5	220,000	1200.00	718.80
VS-VP96-50	150,000	790.00	473.21
	611000	3250.00	1946.75

PCE Soil Concentration Calculations from Soil Gas Data
Polygon 96, Jan/Feb-1993 Phase II Investgation

Sample #	PCE Conc (ppbV)	PCE Conc (ug/L)*	PCE Conc (ug/Kg)**
VS-VP96-13	0.0	0.00	0.00
VS-VP96-26.5	0.0	0.00	0.00
VS-VP96-37.5	0.0	0.00	0.00
VS-VP96-50	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 96 Soil Gas Data

Interpolated Concentrations
Polygon 96, Jan/Feb-1993 Phase II Investgation

Depth (feet)	*Conc. (ug/kg)*
3	22.117
9	66.351
15	179.256
21	429.505
27	661.623
33	694.295
39	689.329
45	571.45
51	473.21
57	473.21
60	473.21

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PGA VLEACH model, Jan/Feb 1993 Phase II Investigation
  1
    1.0      60.     1.0      10.
   123.6     .473    1100.    .7029
Polygon 92
   83000       1.  .196850     1.64     .381     .255   .00074
     0.        0.      -1.
  60
  1   6    22.12
  7  12    66.35
  13  18   179.26
  19  24   429.51
  25  30   661.62
  31  36   694.30
  37  42   689.33
  43  48   571.45
  49  54   473.21
  55  60   473.21
```

GROUNDWATER IMPACT OF POLYGON 1

Time	Mass per area (g/sq.ft.)	Total Mass (g)
1.00	.93108E-02	772.80
2.00	.93320E-02	774.56
3.00	.93579E-02	776.71
4.00	.93890E-02	779.29
5.00	.94256E-02	782.32
6.00	.94680E-02	785.85
7.00	.95166E-02	789.88
8.00	.95715E-02	794.44
9.00	.96328E-02	799.53
10.00	.97004E-02	805.13
11.00	.97740E-02	811.24
12.00	.98530E-02	817.80
13.00	.99369E-02	824.76
14.00	.10025E-01	832.06
15.00	.10116E-01	839.60
16.00	.10209E-01	847.32
17.00	.10303E-01	855.12
18.00	.10397E-01	862.92
19.00	.10490E-01	870.63
20.00	.10580E-01	878.18
21.00	.10669E-01	885.50
22.00	.10753E-01	892.52
23.00	.10834E-01	899.19
24.00	.10909E-01	905.47
25.00	.10980E-01	911.32
26.00	.11044E-01	916.69
27.00	.11103E-01	921.56
28.00	.11156E-01	925.91
29.00	.11201E-01	929.72
30.00	.11241E-01	932.98
31.00	.11273E-01	935.67
32.00	.11299E-01	937.80
33.00	.11317E-01	939.35
34.00	.11329E-01	940.32
35.00	.11334E-01	940.73
36.00	.11332E-01	940.56
37.00	.11323E-01	939.84
38.00	.11308E-01	938.56
39.00	.11286E-01	936.74
40.00	.11258E-01	934.39
41.00	.11223E-01	931.52
42.00	.11182E-01	928.15

43.00	.11136E-01	924.28
44.00	.11084E-01	919.95
45.00	.11026E-01	915.16
46.00	.10963E-01	909.94
47.00	.10895E-01	904.29
48.00	.10822E-01	898.24
49.00	.10745E-01	891.81
50.00	.10663E-01	885.01
51.00	.10577E-01	877.87
52.00	.10487E-01	870.41
53.00	.10393E-01	862.64
54.00	.10296E-01	854.58
55.00	.10196E-01	846.25
56.00	.10092E-01	837.68
57.00	.99864E-02	828.87
58.00	.98778E-02	819.86
59.00	.97668E-02	810.64
60.00	.96537E-02	801.26

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TOTAL GROUNDWATER IMPACT

Time (yr)	Mass (g)	Cumulative Mass (g)
1.00	772.80	772.80
2.00	774.56	1547.4
3.00	776.71	2324.1
4.00	779.29	3103.4
5.00	782.32	3885.7
6.00	785.85	4671.5
7.00	789.88	5461.4
8.00	794.44	6255.8
9.00	799.53	7055.4
10.00	805.13	7860.5
11.00	811.24	8671.7
12.00	817.80	9489.5
13.00	824.76	10314.
14.00	832.06	11146.
15.00	839.60	11986.
16.00	847.32	12833.
17.00	855.12	13688.
18.00	862.92	14551.
19.00	870.63	15422.
20.00	878.18	16300.
21.00	885.50	17186.

22.00	892.52	18078.
23.00	899.19	18977.
24.00	905.47	19883.
25.00	911.32	20794.
26.00	916.69	21711.
27.00	921.56	22632.
28.00	925.91	23558.
29.00	929.72	24488.
30.00	932.98	25421.
31.00	935.67	26357.
32.00	937.80	27294.
33.00	939.35	28234.
34.00	940.32	29174.
35.00	940.73	30115.
36.00	940.56	31055.
37.00	939.84	31995.
38.00	938.56	32934.
39.00	936.74	33871.
40.00	934.39	34805.
41.00	931.52	35736.
42.00	928.15	36665.
43.00	924.28	37589.
44.00	919.95	38509.
45.00	915.16	39424.
46.00	909.94	40334.
47.00	904.29	41238.
48.00	898.24	42136.
49.00	891.81	43028.
50.00	885.01	43913.
51.00	877.87	44791.
52.00	870.41	45662.
53.00	862.64	46524.
54.00	854.58	47379.
55.00	846.25	48225.
56.00	837.68	49063.
57.00	828.87	49892.
58.00	819.86	50711.
59.00	810.64	51522.
60.00	801.26	52323.

MIXCELL OUTPUT FILE

PGA VLEACH model Polygon 96 Jan/Feb 1993 Phase II Investigation

Year	Mass (grams)	GW Conc (ug/L)
1	772.800	10.5782
2	774.560	16.1377
3	776.710	19.0764
4	779.290	20.6494
5	782.320	21.5141
6	785.850	22.0149
7	789.880	22.3321
8	794.440	22.5605
9	799.530	22.7497
10	805.130	22.9254
11	811.240	23.1009
12	817.800	23.2826
13	824.760	23.4729
14	832.060	23.6724
15	839.600	23.8800
16	847.320	24.0943
17	855.120	24.3133
18	862.920	24.5346
19	870.630	24.7559
20	878.180	24.9751
21	885.500	25.1900
22	892.520	25.3985
23	899.190	25.5990
24	905.470	25.7898
25	911.320	25.9698
26	916.690	26.1374
27	921.560	26.2918
28	925.910	26.4322
29	929.720	26.5577
30	932.980	26.6681
31	935.670	26.7626
32	937.800	26.8413
33	939.350	26.9037
34	940.320	26.9496
35	940.730	26.9792
36	940.560	26.9924
37	939.840	26.9894
38	938.560	26.9704

39	936.740	26.9355
40	934.390	26.8850
41	931.520	26.8194
42	928.150	26.7389
43	924.280	26.6438
44	919.950	26.5348
45	915.160	26.4121
46	909.940	26.2765
47	904.290	26.1282
48	898.240	25.9678
49	891.810	25.7958
50	885.010	25.6128
51	877.870	25.4192
52	870.410	25.2159
53	862.640	25.0031
54	854.580	24.7814
55	846.250	24.5514
56	837.680	24.3137
57	828.870	24.0687
58	819.860	23.8172
59	810.640	23.5594
60	801.260	23.2961

Polygon 96 Soil Gas Data

Total Soil Concentration Calculations from Soil Gas Data
Polygon 96, 2/93 Data, ARM run (90% reduction at 37.5' & 50', 70% at 26.5')

Sample #	Total Clx Conc (ppbV)	Total Clx Conc (ug/L)*	Total Clx Conc (ug/Kg)**
VS-VP96-13	31000	160.00	95.84
VS-VP96-26.5	63000	330.00	197.67
VS-VP96-37.5	22000	120.00	71.88
VS-VP96-50	15000	79.00	47.32
	131000	689.00	412.71

*Laboratory conversion from ppbV to ug/L
**Multiply ug/L concentration by 0.599 L/Kg (calculated Kgt based on revised soil physical data).

1,1-DCE Soil Concentration Calculations from Soil Gas Data
Polygon 96, 2/93 Data, ARM run (90% reduction at 37.5' & 50', 70% at 26.5')

Sample #	1,1-DCE Conc (ppbV)	1,1-DCE Conc (ug/L)*	1,1-DCE Conc (ug/Kg)**
VS-VP96-13	0	0.00	0.00
VS-VP96-26.5	0	0.00	0.00
VS-VP96-37.5	0	0.00	0.00
VS-VP96-50	0	0.00	0.00
	0.00	0.00	0.00

1,1,1-TCA Soil Concentration Calculations from Soil Gas Data
Polygon 96, 2/93 Data, ARM run (90% reduction at 37.5' & 50', 70% at 26.5')

Sample #	1,1,1-TCA Conc (ppbV)	1,1,1-TCA Conc (ug/L)*	1,1,1-TCA Conc (ug/Kg)**
VS-VP96-13	0.0	0.00	0.00
VS-VP96-26.5	0.0	0.00	0.00
VS-VP96-37.5	0.0	0.00	0.00
VS-VP96-50	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 96 Soil Gas Data

TCE Soil Concentration Calculations from Soil Gas Data
Polygon 96, 2/93 Data, ARM run (90% reduction at 37.5' & 50', 70% at 26.5')

Sample #	TCE Conc (ppbV)	TCE Conc (ug/L)*	TCE Conc (ug/Kg)**
VS-VP96-13	31,000	160.00	95.84
VS-VP96-26.5	63,000	330.00	197.67
VS-VP96-37.5	22,000	120.00	71.88
VS-VP96-50	15,000	79.00	47.32
	131000	689.00	412.71

PCE Soil Concentration Calculations from Soil Gas Data
Polygon 96, 2/93 Data, ARM run (90% reduction at 37.5' & 50', 70% at 26.5')

Sample #	PCE Conc (ppbV)	PCE Conc (ug/L)*	PCE Conc (ug/Kg)**
VS-VP96-13	0.0	0.00	0.00
VS-VP96-26.5	0.0	0.00	0.00
VS-VP96-37.5	0.0	0.00	0.00
VS-VP96-50	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 96 Soil Gas Data

Interpolated Concentrations
Polygon 96, 2/93 Data, ARM run
(90% reduction at 37.5' & 50', 70% at 26.5')

Depth (feet)	*Conc. (ug/kg)*
3	22.117
9	66.351
15	110.926
21	156.184
27	191.952
33	123.340
39	68.933
45	57.14
51	47.32
57	47.32
60	47.32

PGA VLEACH model Poly 96, 2/93 Data, ARM run (90% at 37.5 & 50, 70% at 26.5)

```
  1
   1.0    100.    1.0    10.
  123.6    .473   1100.   .7029
Polygon 92
  83000     1.  .196850    1.64    .381    .255  .00074
    0.      0.     -1.
 60
  1   6   21.12
  7  12   66.35
 13  18  110.93
 19  24  156.18
 25  30  191.95
 31  36  123.34
 37  42   68.93
 43  48   57.14
 49  54   47.32
 55  60   47.32
```

PGA VLEACH model Poly 96, 2/93 Data, ARM run (90% at 37.5 & 50, 70% at 26.5)

GROUNDWATER IMPACT OF POLYGON 1

Time	Mass per area (g/sq.ft.)	Total Mass (g)
1.00	.93106E-03	77.278
2.00	.93395E-03	77.518
3.00	.93761E-03	77.821
4.00	.94215E-03	78.198
5.00	.94766E-03	78.656
6.00	.95427E-03	79.204
7.00	.96205E-03	79.850
8.00	.97110E-03	80.601
9.00	.98150E-03	81.464
10.00	.99331E-03	82.444
11.00	.10066E-02	83.545
12.00	.10213E-02	84.768
13.00	.10375E-02	86.113
14.00	.10552E-02	87.579
15.00	.10743E-02	89.163
16.00	.10947E-02	90.860
17.00	.11165E-02	92.666
18.00	.11394E-02	94.574
19.00	.11636E-02	96.579
20.00	.11889E-02	98.675
21.00	.12151E-02	100.85
22.00	.12423E-02	103.11
23.00	.12703E-02	105.44
24.00	.12991E-02	107.83
25.00	.13286E-02	110.27
26.00	.13586E-02	112.76
27.00	.13891E-02	115.30
28.00	.14200E-02	117.86
29.00	.14511E-02	120.44
30.00	.14824E-02	123.04
31.00	.15137E-02	125.64
32.00	.15450E-02	128.23
33.00	.15760E-02	130.81
34.00	.16068E-02	133.36
35.00	.16371E-02	135.88
36.00	.16668E-02	138.35
37.00	.16960E-02	140.77
38.00	.17243E-02	143.12
39.00	.17519E-02	145.40
40.00	.17784E-02	147.61

41.00	.18040E-02	149.73
42.00	.18284E-02	151.76
43.00	.18517E-02	153.69
44.00	.18737E-02	155.52
45.00	.18944E-02	157.23
46.00	.19138E-02	158.84
47.00	.19317E-02	160.33
48.00	.19483E-02	161.71
49.00	.19634E-02	162.96
50.00	.19771E-02	164.10
51.00	.19893E-02	165.11
52.00	.20000E-02	166.00
53.00	.20093E-02	166.77
54.00	.20171E-02	167.42
55.00	.20235E-02	167.95
56.00	.20284E-02	168.36
57.00	.20319E-02	168.65
58.00	.20341E-02	168.83
59.00	.20349E-02	168.90
60.00	.20344E-02	168.85
61.00	.20326E-02	168.71
62.00	.20296E-02	168.46
63.00	.20254E-02	168.11
64.00	.20200E-02	167.66
65.00	.20135E-02	167.12
66.00	.20059E-02	166.49
67.00	.19973E-02	165.77
68.00	.19877E-02	164.98
69.00	.19771E-02	164.10
70.00	.19657E-02	163.15
71.00	.19534E-02	162.13
72.00	.19402E-02	161.04
73.00	.19263E-02	159.89
74.00	.19117E-02	158.67
75.00	.18964E-02	157.40
76.00	.18805E-02	156.08
77.00	.18639E-02	154.71
78.00	.18468E-02	153.29
79.00	.18292E-02	151.82
80.00	.18111E-02	150.32
81.00	.17925E-02	148.78
82.00	.17735E-02	147.20
83.00	.17541E-02	145.59
84.00	.17344E-02	143.96
85.00	.17144E-02	142.29

86.00	.16941E-02	140.61
87.00	.16735E-02	138.90
88.00	.16527E-02	137.18
89.00	.16318E-02	135.44
90.00	.16106E-02	133.68
91.00	.15893E-02	131.92
92.00	.15679E-02	130.14
93.00	.15464E-02	128.36
94.00	.15249E-02	126.57
95.00	.15033E-02	124.77
96.00	.14816E-02	122.97
97.00	.14600E-02	121.18
98.00	.14383E-02	119.38
99.00	.14167E-02	117.59
100.00	.13951E-02	115.80

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TOTAL GROUNDWATER IMPACT

Time (yr)	Mass (g)	Cumulative Mass (g)
1.00	77.278	77.278
2.00	77.518	154.80
3.00	77.821	232.62
4.00	78.198	310.82
5.00	78.656	389.47
6.00	79.204	468.68
7.00	79.850	548.53
8.00	80.601	629.13
9.00	81.464	710.59
10.00	82.444	793.04
11.00	83.545	876.58
12.00	84.768	961.35
13.00	86.113	1047.5
14.00	87.579	1135.0
15.00	89.163	1224.2
16.00	90.860	1315.1
17.00	92.666	1407.7
18.00	94.574	1502.3
19.00	96.579	1598.9
20.00	98.675	1697.6
21.00	100.85	1798.4
22.00	103.11	1901.5
23.00	105.44	2007.0
24.00	107.83	2114.8

25.00	110.27	2225.1
26.00	112.76	2337.8
27.00	115.30	2453.1
28.00	117.86	2571.0
29.00	120.44	2691.4
30.00	123.04	2814.5
31.00	125.64	2940.1
32.00	128.23	3068.3
33.00	130.81	3199.1
34.00	133.36	3332.5
35.00	135.88	3468.4
36.00	138.35	3606.7
37.00	140.77	3747.5
38.00	143.12	3890.6
39.00	145.40	4036.0
40.00	147.61	4183.6
41.00	149.73	4333.3
42.00	151.76	4485.1
43.00	153.69	4638.8
44.00	155.52	4794.3
45.00	157.23	4951.5
46.00	158.84	5110.4
47.00	160.33	5270.7
48.00	161.71	5432.4
49.00	162.96	5595.4
50.00	164.10	5759.5
51.00	165.11	5924.6
52.00	166.00	6090.6
53.00	166.77	6257.4
54.00	167.42	6424.8
55.00	167.95	6592.7
56.00	168.36	6761.1
57.00	168.65	6929.8
58.00	168.83	7098.6
59.00	168.90	7267.5
60.00	168.85	7436.3
61.00	168.71	7605.0
62.00	168.46	7773.5
63.00	168.11	7941.6
64.00	167.66	8109.3
65.00	167.12	8276.4
66.00	166.49	8442.9
67.00	165.77	8608.6
68.00	164.98	8773.6
69.00	164.10	8937.7

70.00	163.15	9100.9
71.00	162.13	9263.0
72.00	161.04	9424.0
73.00	159.89	9583.9
74.00	158.67	9742.6
75.00	157.40	9900.0
76.00	156.08	10056.
77.00	154.71	10211.
78.00	153.29	10364.
79.00	151.82	10516.
80.00	150.32	10666.
81.00	148.78	10815.
82.00	147.20	10962.
83.00	145.59	11108.
84.00	143.96	11252.
85.00	142.29	11394.
86.00	140.61	11535.
87.00	138.90	11674.
88.00	137.18	11811.
89.00	135.44	11946.
90.00	133.68	12080.
91.00	131.92	12212.
92.00	130.14	12342.
93.00	128.36	12470.
94.00	126.57	12597.
95.00	124.77	12722.
96.00	122.97	12845.
97.00	121.18	12966.
98.00	119.38	13085.
99.00	117.59	13203.
100.00	115.80	13319.

MIXCELL OUTPUT FILE

PGA VLEACH model Poly 96

Poly 96, 2/93 Data, ARM run
(90% at 37.5 & 50, 70% at 26.5)

Year	Mass (grams)	GW Conc (ug/L)
1	77.278	1.0578
2	77.518	1.6146
3	77.821	1.9101
4	78.198	2.0699
5	78.656	2.1598
6	79.204	2.2144
7	79.850	2.2517
8	80.601	2.2816
9	81.464	2.3090
10	82.444	2.3368
11	83.545	2.3664
12	84.768	2.3986
13	86.113	2.4339
14	87.579	2.4724
15	89.163	2.5143
16	90.860	2.5594
17	92.666	2.6077
18	94.574	2.6591
19	96.579	2.7135
20	98.675	2.7706
21	100.850	2.8303
22	103.110	2.8924
23	105.440	2.9568
24	107.830	3.0233
25	110.270	3.0914
26	112.760	3.1612
27	115.300	3.2324
28	117.860	3.3048
29	120.440	3.3779
30	123.040	3.4518
31	125.640	3.5261
32	128.230	3.6004
33	130.810	3.6746
34	133.360	3.7483
35	135.880	3.8214
36	138.350	3.8934
37	140.770	3.9643

38	143.120	4.0335
39	145.400	4.1009
40	147.610	4.1665
41	149.730	4.2298
42	151.760	4.2907
43	153.690	4.3490
44	155.520	4.4046
45	157.230	4.4570
46	158.840	4.5065
47	160.330	4.5528
48	161.710	4.5959
49	162.960	4.6356
50	164.100	4.6720
51	165.110	4.7048
52	166.000	4.7342
53	166.770	4.7601
54	167.420	4.7826
55	167.950	4.8016
56	168.360	4.8171
57	168.650	4.8293
58	168.830	4.8381
59	168.900	4.8436
60	168.850	4.8458
61	168.710	4.8451
62	168.460	4.8413
63	168.110	4.8345
64	167.660	4.8248
65	167.120	4.8123
66	166.490	4.7972
67	165.770	4.7794
68	164.980	4.7593
69	164.100	4.7367
70	163.150	4.7119
71	162.130	4.6849
72	161.040	4.6559
73	159.890	4.6250
74	158.670	4.5921
75	157.400	4.5575
76	156.080	4.5213
77	154.710	4.4836
78	153.290	4.4445
79	151.820	4.4039
80	150.320	4.3621
81	148.780	4.3191
82	147.200	4.2750

83	145.590	4.2299
84	143.960	4.1840
85	142.290	4.1371
86	140.610	4.0896
87	138.900	4.0413
88	137.180	3.9925
89	135.440	3.9431
90	133.680	3.8932
91	131.920	3.8430
92	130.140	3.7924
93	128.360	3.7415
94	126.570	3.6904
95	124.770	3.6390
96	122.970	3.5875
97	121.180	3.5360
98	119.380	3.4844
99	117.590	3.4329
%100	115.800	3.3815

Polygon 96 Soil Gas Data

Total Soil Concentration Calculations from Soil Gas Data
Polygon 96, 2/93 Data, ARM run (97% reduction at 37.5' & 50', 95% at 26.5', 50% at 13')

Sample #	Total Clx Conc (ppbV)	Total Clx Conc (ug/L)*	Total Clx Conc (ug/Kg)**
VS-VP96-13	15500	80.00	47.92
VS-VP96-26.5	10500	55.00	32.95
VS-VP96-37.5	6600	36.00	21.56
VS-VP96-50	4500	23.70	14.20
	37100	194.70	116.63

*Laboratory conversion from ppbV to ug/L
**Multiply ug/L concentration by 0.599 L/Kg (calculated Kgt based on revised soil physical data).

1,1-DCE Soil Concentration Calculations from Soil Gas Data
Polygon 96, 2/93 Data, ARM run (97% reduction at 37.5' & 50', 95% at 26.5', 50% at 13')

Sample #	1,1-DCE Conc (ppbV)	1,1-DCE Conc (ug/L)*	1,1-DCE Conc (ug/Kg)**
VS-VP96-13	0	0.00	0.00
VS-VP96-26.5	0	0.00	0.00
VS-VP96-37.5	0	0.00	0.00
VS-VP96-50	0	0.00	0.00
	0.00	0.00	0.00

1,1,1-TCA Soil Concentration Calculations from Soil Gas Data
Polygon 96, 2/93 Data, ARM run (97% reduction at 37.5' & 50', 95% at 26.5', 50% at 13')

Sample #	1,1,1-TCA Conc (ppbV)	1,1,1-TCA Conc (ug/L)*	1,1,1-TCA Conc (ug/Kg)**
VS-VP96-13	0.0	0.00	0.00
VS-VP96-26.5	0.0	0.00	0.00
VS-VP96-37.5	0.0	0.00	0.00
VS-VP96-50	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 96 Soil Gas Data

TCE Soil Concentration Calculations from Soil Gas Data
Polygon 96, 2/93 Data, ARM run (97% reduction at 37.5' & 50', 95% at 26.5', 50% at 13')

Sample #	TCE Conc (ppbV)	TCE Conc (ug/L)*	TCE Conc (ug/Kg)**
VS-VP96-13	15,500	80.00	47.92
VS-VP96-26.5	10,500	55.00	32.95
VS-VP96-37.5	6,600	36.00	21.56
VS-VP96-50	4,500	23.70	14.20
	37100	194.70	116.63

PCE Soil Concentration Calculations from Soil Gas Data
Polygon 96, 2/93 Data, ARM run (97% reduction at 37.5' & 50', 95% at 26.5', 50% at 13')

Sample #	PCE Conc (ppbV)	PCE Conc (ug/L)*	PCE Conc (ug/Kg)**
VS-VP96-13	0.0	0.00	0.00
VS-VP96-26.5	0.0	0.00	0.00
VS-VP96-37.5	0.0	0.00	0.00
VS-VP96-50	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 96 Soil Gas Data

Interpolated Concentrations
Polygon 96, 2/93 Data, ARM run
(97% reduction at 37.5' & 50', 95% at 26.5', 50% at 13')

Depth (feet)	*Conc. (ug/kg)*
3	11.058
9	33.175
15	45.701
21	39.046
27	32.428
33	26.220
39	20.680
45	17.14
51	14.20
57	14.20
60	14.20

PGA VLEACH model Poly 96, 2/93 Data, ARM run (97% at 37.5 & 50, 95% at 26.5, 50% at 13)

```
 1
   1.0   100.    1.0     10.
  123.6   .473   1100.   .7029
Polygon 92
  83000     1.  .196850    1.64     .381     .255   .00074
    0.       0.     -1.
 60
 1   6    11.06
 7  12    33.18
13  18    45.70
19  24    39.05
25  30    32.43
31  36    26.22
37  42    20.68
43  48    17.14
49  54    14.20
55  60    14.20
```

PGA VLEACH model, Poly 96 2/93 Data, ARM run (97% at 37.5 & 50, 95% at 26.5, 50% at 13)

GROUNDWATER IMPACT OF POLYGON 1

Time	Mass per area (g/sq.ft.)	Total Mass (g)
1.00	.27940E-03	23.190
2.00	.28012E-03	23.250
3.00	.28102E-03	23.325
4.00	.28213E-03	23.417
5.00	.28345E-03	23.526
6.00	.28501E-03	23.656
7.00	.28683E-03	23.807
8.00	.28893E-03	23.981
9.00	.29131E-03	24.179
10.00	.29399E-03	24.401
11.00	.29696E-03	24.648
12.00	.30023E-03	24.919
13.00	.30379E-03	25.214
14.00	.30762E-03	25.532
15.00	.31171E-03	25.872
16.00	.31604E-03	26.231
17.00	.32058E-03	26.608
18.00	.32532E-03	27.002
19.00	.33024E-03	27.410
20.00	.33532E-03	27.831
21.00	.34053E-03	28.264
22.00	.34586E-03	28.707
23.00	.35130E-03	29.158
24.00	.35683E-03	29.617
25.00	.36245E-03	30.083
26.00	.36812E-03	30.554
27.00	.37385E-03	31.030
28.00	.37963E-03	31.509
29.00	.38543E-03	31.991
30.00	.39126E-03	32.474
31.00	.39709E-03	32.958
32.00	.40292E-03	33.442
33.00	.40873E-03	33.925
34.00	.41452E-03	34.405
35.00	.42026E-03	34.882
36.00	.42596E-03	35.354
37.00	.43158E-03	35.822
38.00	.43714E-03	36.282
39.00	.44260E-03	36.736

40.00	.44796E-03	37.181
41.00	.45321E-03	37.616
42.00	.45833E-03	38.041
43.00	.46331E-03	38.455
44.00	.46815E-03	38.856
45.00	.47282E-03	39.244
46.00	.47733E-03	39.618
47.00	.48165E-03	39.977
48.00	.48578E-03	40.320
49.00	.48972E-03	40.646
50.00	.49344E-03	40.956
51.00	.49695E-03	41.247
52.00	.50023E-03	41.519
53.00	.50329E-03	41.773
54.00	.50610E-03	42.006
55.00	.50867E-03	42.220
56.00	.51100E-03	42.413
57.00	.51307E-03	42.585
58.00	.51489E-03	42.736
59.00	.51646E-03	42.866
60.00	.51776E-03	42.974
61.00	.51880E-03	43.060
62.00	.51958E-03	43.125
63.00	.52010E-03	43.168
64.00	.52036E-03	43.190
65.00	.52036E-03	43.190
66.00	.52010E-03	43.168
67.00	.51959E-03	43.126
68.00	.51883E-03	43.063
69.00	.51782E-03	42.979
70.00	.51657E-03	42.875
71.00	.51508E-03	42.752
72.00	.51336E-03	42.609
73.00	.51141E-03	42.447
74.00	.50924E-03	42.267
75.00	.50686E-03	42.069
76.00	.50426E-03	41.854
77.00	.50147E-03	41.622
78.00	.49848E-03	41.374
79.00	.49531E-03	41.111
80.00	.49196E-03	40.832
81.00	.48843E-03	40.540
82.00	.48475E-03	40.234
83.00	.48090E-03	39.915
84.00	.47691E-03	39.584

85.00	.47278E-03	39.241
86.00	.46852E-03	38.887
87.00	.46414E-03	38.523
88.00	.45964E-03	38.150
89.00	.45503E-03	37.767
90.00	.45031E-03	37.376
91.00	.44551E-03	36.977
92.00	.44062E-03	36.571
93.00	.43565E-03	36.159
94.00	.43061E-03	35.740
95.00	.42550E-03	35.317
96.00	.42034E-03	34.888
97.00	.41512E-03	34.455
98.00	.40986E-03	34.018
99.00	.40456E-03	33.578
100.00	.39923E-03	33.136

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TOTAL GROUNDWATER IMPACT

Time (yr)	Mass (g)	Cumulative Mass (g)
1.00	23.190	23.190
2.00	23.250	46.440
3.00	23.325	69.765
4.00	23.417	93.182
5.00	23.526	116.71
6.00	23.656	140.36
7.00	23.807	164.17
8.00	23.981	188.15
9.00	24.179	212.33
10.00	24.401	236.73
11.00	24.648	261.38
12.00	24.919	286.30
13.00	25.214	311.51
14.00	25.532	337.05
15.00	25.872	362.92
16.00	26.231	389.15
17.00	26.608	415.76
18.00	27.002	442.76
19.00	27.410	470.17
20.00	27.831	498.00
21.00	28.264	526.26
22.00	28.707	554.97
23.00	29.158	584.13

24.00	29.617	613.75
25.00	30.083	643.83
26.00	30.554	674.38
27.00	31.030	705.41
28.00	31.509	736.92
29.00	31.991	768.91
30.00	32.474	801.39
31.00	32.958	834.35
32.00	33.442	867.79
33.00	33.925	901.71
34.00	34.405	936.12
35.00	34.882	971.00
36.00	35.354	1006.4
37.00	35.822	1042.2
38.00	36.282	1078.5
39.00	36.736	1115.2
40.00	37.181	1152.4
41.00	37.616	1190.0
42.00	38.041	1228.0
43.00	38.455	1266.5
44.00	38.856	1305.3
45.00	39.244	1344.6
46.00	39.618	1384.2
47.00	39.977	1424.2
48.00	40.320	1464.5
49.00	40.646	1505.1
50.00	40.956	1546.1
51.00	41.247	1587.3
52.00	41.519	1628.9
53.00	41.773	1670.6
54.00	42.006	1712.6
55.00	42.220	1754.9
56.00	42.413	1797.3
57.00	42.585	1839.9
58.00	42.736	1882.6
59.00	42.866	1925.5
60.00	42.974	1968.4
61.00	43.060	2011.5
62.00	43.125	2054.6
63.00	43.168	2097.8
64.00	43.190	2141.0
65.00	43.190	2184.2
66.00	43.168	2227.3
67.00	43.126	2270.5
68.00	43.063	2313.5

69.00	42.979	2356.5
70.00	42.875	2399.4
71.00	42.752	2442.1
72.00	42.609	2484.7
73.00	42.447	2527.2
74.00	42.267	2569.5
75.00	42.069	2611.5
76.00	41.854	2653.4
77.00	41.622	2695.0
78.00	41.374	2736.4
79.00	41.111	2777.5
80.00	40.832	2818.3
81.00	40.540	2858.9
82.00	40.234	2899.1
83.00	39.915	2939.0
84.00	39.584	2978.6
85.00	39.241	3017.8
86.00	38.887	3056.7
87.00	38.523	3095.2
88.00	38.150	3133.4
89.00	37.767	3171.2
90.00	37.376	3208.5
91.00	36.977	3245.5
92.00	36.571	3282.1
93.00	36.159	3318.2
94.00	35.740	3354.0
95.00	35.317	3389.3
96.00	34.888	3424.2
97.00	34.455	3458.6
98.00	34.018	3492.7
99.00	33.578	3526.2
100.00	33.136	3559.4

MIXCELL OUTPUT FILE

PGA VLEACH model

Polygon 96, 2/93 Data, ARM run
(97% at 37.5 & 50, 95% at 26.5, 50% at 13)

Year	Mass (grams)	GW Conc (ug/L)
1	23.190	0.3174
2	23.250	0.4844
3	23.325	0.5727
4	23.417	0.6202
5	23.526	0.6466
6	23.656	0.6622
7	23.807	0.6724
8	23.981	0.6801
9	24.179	0.6869
10	24.401	0.6934
11	24.648	0.7002
12	24.919	0.7075
13	25.214	0.7154
14	25.532	0.7238
15	25.872	0.7329
16	26.231	0.7426
17	26.608	0.7528
18	27.002	0.7635
19	27.410	0.7747
20	27.831	0.7864
21	28.264	0.7984
22	28.707	0.8107
23	29.158	0.8234
24	29.617	0.8363
25	30.083	0.8494
26	30.554	0.8627
27	31.030	0.8762
28	31.509	0.8898
29	31.991	0.9035
30	32.474	0.9173
31	32.958	0.9311
32	33.442	0.9450
33	33.925	0.9589
34	34.405	0.9727
35	34.882	0.9865
36	35.354	1.0001
37	35.822	1.0137

38	36.282	1.0271
39	36.736	1.0403
40	37.181	1.0533
41	37.616	1.0661
42	38.041	1.0786
43	38.455	1.0908
44	38.856	1.1027
45	39.244	1.1142
46	39.618	1.1253
47	39.977	1.1361
48	40.320	1.1464
49	40.646	1.1563
50	40.956	1.1657
51	41.247	1.1746
52	41.519	1.1830
53	41.773	1.1908
54	42.006	1.1981
55	42.220	1.2049
56	42.413	1.2111
57	42.585	1.2166
58	42.736	1.2216
59	42.866	1.2260
60	42.974	1.2298
61	43.060	1.2329
62	43.125	1.2355
63	43.168	1.2374
64	43.190	1.2387
65	43.190	1.2394
66	43.168	1.2394
67	43.126	1.2389
68	43.063	1.2378
69	42.979	1.2360
70	42.875	1.2337
71	42.752	1.2308
72	42.609	1.2273
73	42.447	1.2232
74	42.267	1.2187
75	42.069	1.2136
76	41.854	1.2079
77	41.622	1.2018
78	41.374	1.1952
79	41.111	1.1882
80	40.832	1.1807
81	40.540	1.1727
82	40.234	1.1644

83	39.915	1.1557
84	39.584	1.1466
85	39.241	1.1371
86	38.887	1.1273
87	38.523	1.1172
88	38.150	1.1068
89	37.767	1.0962
90	37.376	1.0852
91	36.977	1.0740
92	36.571	1.0626
93	36.159	1.0510
94	35.740	1.0392
95	35.317	1.0272
96	34.888	1.0151
97	34.455	1.0028
98	34.018	0.9904
99	33.578	0.9779
%100	33.136	0.9653

Polgon 96

Run Number	Soil Vapor Monitoring Piezometer Designation	Modelled Total Soil Concentration (ug/Kg) in each Piezometer	Percentage Reduction from Actual Concentration	Approximate Corresponding Soil Vapor Concentration (Converted from ug/L to ppmV as TCE)	Modelled Maximum Subunit A Impact to Groundwater (ug/L)
1	VS-VP96-13	95.84	0	29.3	
	VS-VP96-26.5	658.90	0	201.3	26.9924
	VS-VP96-37.5	718.80	0	219.6	
	VS-VP96-50	473.21	0	144.5	
2	VS-VP96-13	95.84	0	29.3	
	VS-VP96-26.5	197.67	70	60.4	4.8458
	VS-VP96-37.5	71.88	90	22.0	
	VS-VP96-50	47.32	90	14.5	
3	VS-VP96-13	47.92	50	14.6	
	VS-VP96-26.5	32.95	95	10.1	1.2394
	VS-VP96-37.5	21.56	97	6.6	
	VS-VP96-50	14.20	97	4.3	

Polygon 92 Soil Gas Data

Total Soil Concentration Calculations from Soil Gas Data
Polygon 92, June-1992 Phase II Investgation

Sample #	Total Clx Conc (ppbV)	Total Clx Conc (ug/L)*	Total Clx Conc (ug/Kg)**
VS-VP27A-12	34926	143.01	85.66
VS-VP27A-21	167400	693.00	415.11
VS-VP27A-36	211300	887.00	531.31
VS-VP27A-45	439800	2005.00	1201.00
	853426	3728.01	2233.08

*Laboratory conversion from ppbV to ug/L
**Multiply ug/L concentration by 0.599 L/Kg (calculated Kgt based on revised soil physical data).

1,1-DCE Soil Concentration Calculations from Soil Gas Data
Polygon 92, June-1992 Phase II Investgation

Sample #	1,1-DCE Conc (ppbV)	1,1-DCE Conc (ug/L)*	1,1-DCE Conc (ug/Kg)**
VS-VP27A-12	30,000	116.00	69.48
VS-VP27A-21	140,000	540.00	323.46
VS-VP27A-36	170,000	660.00	395.34
VS-VP27A-45	270,000	1100.00	658.90
	610000.00	2416.00	1447.18

1,1,1-TCA Soil Concentration Calculations from Soil Gas Data
Polygon 92, June-1992 Phase II Investgation

Sample #	1,1,1-TCA Conc (ppbV)	1,1,1-TCA Conc (ug/L)*	1,1,1-TCA Conc (ug/Kg)**
VS-VP27A-12	96.0	0.51	0.31
VS-VP27A-21	4800.0	26.00	15.57
VS-VP27A-36	16000.0	85.00	50.92
VS-VP27A-45	160000.0	850.00	509.15
	180896.0	961.51	575.94

Polygon 92 Soil Gas Data

TCE Soil Concentration Calculations from Soil Gas Data
Polygon 92, June-1992 Phase II Investgation

Sample #	TCE Conc (ppbV)	TCE Conc (ug/L)*	TCE Conc (ug/Kg)**
VS-VP27A-12	4,300	23.00	13.78
VS-VP27A-21	20,000	110.00	65.89
VS-VP27A-36	22,000	120.00	71.88
VS-VP27A-45	7,400	39.00	23.36
	53700	292.00	174.91

PCE Soil Concentration Calculations from Soil Gas Data
Polygon 92, June-1992 Phase II Investgation

Sample #	PCE Conc (ppbV)	PCE Conc (ug/L)*	PCE Conc (ug/Kg)**
VS-VP27A-12	530.0	3.50	2.10
VS-VP27A-21	2600.0	17.00	10.18
VS-VP27A-36	3300.0	22.00	13.18
VS-VP27A-45	2400.0	16.00	9.58
	8830.0	58.50	35.04

Polygon 92 Soil Gas Data

Interpolated Concentrations
Polygon 92, June-1992 Phase II Investgation

Depth (feet)	*Conc. (ug/kg)*
3	15.117
9	45.351
15	75.585
21	205.461
27	385.158
33	463.526
39	521.629
45	810.35
51	1145.19
57	1201.00
60	1201.00

PGA VLEACH model, Polygon 92 June 1992 Phase II Data

```
  1
    1.0      30.     1.0      10.
   123.6     .473    1100.    .7029
Polygon 92
   87500      1.  .026670    1.64    .381    .255   .00074
     0.       0.      -1.
  60
  1   6    15.12
  7  12    45.35
 13  18    75.59
 19  24   205.46
 25  30   385.16
 31  36   463.53
 37  42   521.63
 43  48   810.35
 49  54  1145.00
 55  60  1201.00
```

GROUNDWATER IMPACT OF POLYGON 1

Time	Mass per area (g/sq.ft.)	Total Mass (g)
1.00	.32016E-02	280.14
2.00	.31875E-02	278.91
3.00	.31729E-02	277.63
4.00	.31576E-02	276.29
5.00	.31418E-02	274.91
6.00	.31256E-02	273.49
7.00	.31090E-02	272.03
8.00	.30920E-02	270.55
9.00	.30748E-02	269.04
10.00	.30573E-02	267.51
11.00	.30396E-02	265.96
12.00	.30217E-02	264.40
13.00	.30037E-02	262.83
14.00	.29857E-02	261.25
15.00	.29675E-02	259.66
16.00	.29494E-02	258.07
17.00	.29313E-02	256.48
18.00	.29131E-02	254.90
19.00	.28950E-02	253.32
20.00	.28770E-02	251.74
21.00	.28591E-02	250.17
22.00	.28412E-02	248.61
23.00	.28235E-02	247.05
24.00	.28059E-02	245.51
25.00	.27884E-02	243.98
26.00	.27710E-02	242.46
27.00	.27538E-02	240.96
28.00	.27368E-02	239.47
29.00	.27199E-02	237.99
30.00	.27032E-02	236.53

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TOTAL GROUNDWATER IMPACT

Time (yr)	Mass (g)	Cumulative Mass (g)
1.00	280.14	280.14
2.00	278.91	559.05
3.00	277.63	836.67
4.00	276.29	1113.0
5.00	274.91	1387.9
6.00	273.49	1661.4

7.00	272.03	1933.4
8.00	270.55	2203.9
9.00	269.04	2473.0
10.00	267.51	2740.5
11.00	265.96	3006.5
12.00	264.40	3270.9
13.00	262.83	3533.7
14.00	261.25	3794.9
15.00	259.66	4054.6
16.00	258.07	4312.7
17.00	256.48	4569.2
18.00	254.90	4824.0
19.00	253.32	5077.4
20.00	251.74	5329.1
21.00	250.17	5579.3
22.00	248.61	5827.9
23.00	247.05	6074.9
24.00	245.51	6320.4
25.00	243.98	6564.4
26.00	242.46	6806.9
27.00	240.96	7047.9
28.00	239.47	7287.3
29.00	237.99	7525.3
30.00	236.53	7761.8

MIXCELL OUTPUT FILE

PGA VLEACH model Polygon 92 June 1992 Phase II Data

Year	Mass (grams)	GW Conc (ug/L)
1	280.140	3.6630
2	278.910	5.5968
3	277.630	6.6094
4	276.290	7.1309
5	274.910	7.3905
6	273.490	7.5101
7	272.030	7.5546
8	270.550	7.5590
9	269.040	7.5416
10	267.510	7.5123
11	265.960	7.4765
12	264.400	7.4370
13	262.830	7.3954
14	261.250	7.3527
15	259.660	7.3091
16	258.070	7.2651
17	256.480	7.2209
18	254.900	7.1767
19	253.320	7.1326
20	251.740	7.0884
21	250.170	7.0443
22	248.610	7.0005
23	247.050	6.9568
24	245.510	6.9133
25	243.980	6.8702
26	242.460	6.8274
27	240.960	6.7850
28	239.470	6.7429
29	237.990	6.7012
30	236.530	6.6599

Polygon 92 Soil Gas Data

Total Soil Concentration Calculations from Soil Gas Data
Polygon 92, 9/92 Data, ARM run (35% reduction at 36' & 52')

Sample #	Total Clx Conc (ppbV)	Total Clx Conc (ug/L)*	Total Clx Conc (ug/Kg)**
VS-VP92-17	34926	143.01	85.66
VS-VP92-28	167400	693.00	415.11
VS-VP92-40	137345	576.55	345.35
VS-VP92-52	285870	1303.25	780.65
	625541	2715.81	1626.77

*Laboratory conversion from ppbV to ug/L
**Multiply ug/L concentration by 0.599 L/Kg (calculated Kgt based on revised soil physical data).

1,1-DCE Soil Concentration Calculations from Soil Gas Data
Polygon 92, 9/92 Data, ARM run (35% reduction at 36' & 52')

Sample #	1,1-DCE Conc (ppbV)	1,1-DCE Conc (ug/L)*	1,1-DCE Conc (ug/Kg)**
VS-VP92-17	30,000	116.00	69.48
VS-VP92-28	140,000	540.00	323.46
VS-VP92-40	110,500	429.00	256.97
VS-VP92-52	175,500	715.00	428.29
	456000.00	1800.00	1078.20

1,1,1-TCA Soil Concentration Calculations from Soil Gas Data
Polygon 92, 9/92 Data, ARM run (35% reduction at 36' & 52')

Sample #	1,1,1-TCA Conc (ppbV)	1,1,1-TCA Conc (ug/L)*	1,1,1-TCA Conc (ug/Kg)**
VS-VP92-17	96.0	0.51	0.31
VS-VP92-28	4800.0	26.00	15.57
VS-VP92-40	10400.0	55.25	33.09
VS-VP92-52	104000.0	552.50	330.95
	119296.0	634.26	379.92

Polygon 92 Soil Gas Data

TCE Soil Concentration Calculations from Soil Gas Data
Polygon 92, 9/92 Data, ARM run (35% reduction at 36' & 52')

Sample #	TCE Conc (ppbV)	TCE Conc (ug/L)*	TCE Conc (ug/Kg)**
VS-VP92-17	4,300	23.00	13.78
VS-VP92-28	20,000	110.00	65.89
VS-VP92-40	14,300	78.00	46.72
VS-VP92-52	4,810	25.35	15.18
	43410	236.35	141.57

PCE Soil Concentration Calculations from Soil Gas Data
Polygon 92, 9/92 Data, ARM run (35% reduction at 36' & 52')

Sample #	PCE Conc (ppbV)	PCE Conc (ug/L)*	PCE Conc (ug/Kg)**
VS-VP92-17	530.0	3.50	2.10
VS-VP92-28	2600.0	17.00	10.18
VS-VP92-40	2145.0	14.30	8.57
VS-VP92-52	1560.0	10.40	6.23
	6835.0	45.20	27.07

Polygon 92 Soil Gas Data

Interpolated Concentrations
Polygon 92, 9/92 Data, ARM run (35% reduction at 36' & 52')

Depth (feet)	*Conc. (ug/kg)*
3	15.117
9	45.351
15	75.585
21	205.461
27	385.158
33	386.043
39	351.166
45	526.73
51	744.37
57	780.65
60	780.65

PGA VLEACH model, Polygon 92, 9/92 Data, ARM run (35% at 36 & 52)

```
 1
    1.0     30.     1.0     10.
   123.6    .473    1100.    .7029
Polygon 92
   87500      1.  .026670    1.64     .381     .255   .00074
     0.      0.     -1.
  60
   1   6    15.12
   7  12    45.35
  13  18    75.59
  19  24   205.46
  25  30   385.16
  31  36   386.04
  37  42   351.17
  43  48   526.73
  49  54   744.37
  55  60   780.65
```

PGA VLEACH model, Polygon 92, 9/92 Data, ARM run (35% at 36 & 52)

GROUNDWATER IMPACT OF POLYGON 1

Time	Mass per area (g/sq.ft.)	Total Mass (g)
1.00	.20810E-02	182.09
2.00	.20721E-02	181.31
3.00	.20628E-02	180.49
4.00	.20531E-02	179.65
5.00	.20432E-02	178.78
6.00	.20330E-02	177.88
7.00	.20225E-02	176.97
8.00	.20119E-02	176.04
9.00	.20012E-02	175.10
10.00	.19903E-02	174.15
11.00	.19793E-02	173.19
12.00	.19683E-02	172.22
13.00	.19572E-02	171.25
14.00	.19461E-02	170.28
15.00	.19349E-02	169.31
16.00	.19238E-02	168.33
17.00	.19127E-02	167.36
18.00	.19017E-02	166.40
19.00	.18907E-02	165.44
20.00	.18798E-02	164.48
21.00	.18689E-02	163.53
22.00	.18582E-02	162.59
23.00	.18475E-02	161.66
24.00	.18369E-02	160.73
25.00	.18265E-02	159.81
26.00	.18161E-02	158.91
27.00	.18058E-02	158.01
28.00	.17957E-02	157.12
29.00	.17857E-02	156.25
30.00	.17758E-02	155.38

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TOTAL GROUNDWATER IMPACT

Time (yr)	Mass (g)	Cumulative Mass (g)
1.00	182.09	182.09
2.00	181.31	363.40
3.00	180.49	543.89
4.00	179.65	723.54

5.00	178.78	902.32
6.00	177.88	1080.2
7.00	176.97	1257.2
8.00	176.04	1433.2
9.00	175.10	1608.3
10.00	174.15	1782.5
11.00	173.19	1955.7
12.00	172.22	2127.9
13.00	171.25	2299.1
14.00	170.28	2469.4
15.00	169.31	2638.7
16.00	168.33	2807.1
17.00	167.36	2974.4
18.00	166.40	3140.8
19.00	165.44	3306.3
20.00	164.48	3470.7
21.00	163.53	3634.3
22.00	162.59	3796.9
23.00	161.66	3958.5
24.00	160.73	4119.2
25.00	159.81	4279.1
26.00	158.91	4438.0
27.00	158.01	4596.0
28.00	157.12	4753.1
29.00	156.25	4909.4
30.00	155.38	5064.7

MIXCELL OUTPUT FILE

PGA VLEACH model

Polygon 92, 9/92 Data, ARM run
(35% at 36 & 52)

Year	Mass (grams)	GW Conc (ug/L)
1	182.090	2.3809
2	181.310	3.6381
3	180.490	4.2966
4	179.650	4.6362
5	178.780	4.8055
6	177.880	4.8839
7	176.970	4.9138
8	176.040	4.9175
9	175.100	4.9072
10	174.150	4.8892
11	173.190	4.8672
12	172.220	4.8427
13	171.250	4.8170
14	170.280	4.7907
15	169.310	4.7640
16	168.330	4.7369
17	167.360	4.7098
18	166.400	4.6829
19	165.440	4.6560
20	164.480	4.6291
21	163.530	4.6024
22	162.590	4.5758
23	161.660	4.5496
24	160.730	4.5234
25	159.810	4.4975
26	158.910	4.4719
27	158.010	4.4465
28	157.120	4.4214
29	156.250	4.3966
30	155.380	4.3720

Polygon 92 Soil Gas Data

Total Soil Concentration Calculations from Soil Gas Data
Polygon 92, 9/92 Data, ARM run (84% reduction at 36' & 52')

Sample #	Total Clx Conc (ppbV)	Total Clx Conc (ug/L)*	Total Clx Conc (ug/Kg)**
VS-VP92-17	34926	143.01	85.66
VS-VP92-28	167400	693.00	415.11
VS-VP92-40	33808	141.92	85.01
VS-VP92-52	70368	320.80	192.16
	306502	1298.73	777.94

*Laboratory conversion from ppbV to ug/L
**Multiply ug/L concentration by 0.599 L/Kg (calculated Kgt based on revised soil physical data).

1,1-DCE Soil Concentration Calculations from Soil Gas Data
Polygon 92, 9/92 Data, ARM run (84% reduction at 36' & 52')

Sample #	1,1-DCE Conc (ppbV)	1,1-DCE Conc (ug/L)*	1,1-DCE Conc (ug/Kg)**
VS-VP92-17	30,000	116.00	69.48
VS-VP92-28	140,000	540.00	323.46
VS-VP92-40	27,200	105.60	63.25
VS-VP92-52	43,200	176.00	105.42
	240400.00	937.60	561.62

1,1,1-TCA Soil Concentration Calculations from Soil Gas Data
Polygon 92, 9/92 Data, ARM run (84% reduction at 36' & 52')

Sample #	1,1,1-TCA Conc (ppbV)	1,1,1-TCA Conc (ug/L)*	1,1,1-TCA Conc (ug/Kg)**
VS-VP92-17	96.0	0.51	0.31
VS-VP92-28	4800.0	26.00	15.57
VS-VP92-40	2560.0	13.60	8.15
VS-VP92-52	25600.0	136.00	81.46
	33056.0	176.11	105.49

Polygon 92 Soil Gas Data

TCE Soil Concentration Calculations from Soil Gas Data
Polygon 92, 9/92 Data, ARM run (84% reduction at 36' & 52')

Sample #	TCE Conc (ppbV)	TCE Conc (ug/L)*	TCE Conc (ug/Kg)**
VS-VP92-17	4,300	23.00	13.78
VS-VP92-28	20,000	110.00	65.89
VS-VP92-40	3,520	19.20	11.50
VS-VP92-52	1,184	6.24	3.74
	29004	158.44	94.91

PCE Soil Concentration Calculations from Soil Gas Data
Polygon 92, 9/92 Data, ARM run (84% reduction at 36' & 52')

Sample #	PCE Conc (ppbV)	PCE Conc (ug/L)*	PCE Conc (ug/Kg)**
VS-VP92-17	530.0	3.50	2.10
VS-VP92-28	2600.0	17.00	10.18
VS-VP92-40	528.0	3.52	2.11
VS-VP92-52	384.0	2.56	1.53
	4042.0	26.58	15.92

Polygon 92 Soil Gas Data

Interpolated Concentrations
Polygon 92, 9/92 Data, ARM run (84% reduction at 36' & 52')

Depth (feet)	*Conc. (ug/kg)*
3	15.117
9	45.351
15	75.585
21	205.461
27	385.158
33	277.567
39	112.518
45	129.66
51	183.23
57	192.16
60	192.16

PGA VLEACH model, Polygon 92, 9/92 Data, ARM run (84% at 36 & 52)

```
 1
    1.0     30.     1.0     10.
   123.6    .473    1100.   .7029
Polygon 92
   87500    1.  .026670   1.64   .381   .255  .00074
     0.     0.     -1.
  60
   1   6   15.12
   7  12   45.35
  13  18   75.59
  19  24  205.46
  25  30  385.16
  31  36  277.57
  37  42  112.52
  43  48  129.66
  49  54  183.23
  55  60  192.16
```

PGA VLEACH model, Polygon 92, 9/92 Data, ARM run (84% at 36 & 52)

GROUNDWATER IMPACT OF POLYGON 1

Time	Mass per area (g/sq.ft.)	Total Mass (g)
1.00	.51225E-03	44.822
2.00	.51045E-03	44.664
3.00	.50863E-03	44.505
4.00	.50681E-03	44.346
5.00	.50501E-03	44.188
6.00	.50322E-03	44.031
7.00	.50146E-03	43.877
8.00	.49973E-03	43.726
9.00	.49805E-03	43.579
10.00	.49641E-03	43.436
11.00	.49483E-03	43.298
12.00	.49331E-03	43.164
13.00	.49184E-03	43.036
14.00	.49045E-03	42.914
15.00	.48911E-03	42.797
16.00	.48785E-03	42.687
17.00	.48665E-03	42.582
18.00	.48553E-03	42.484
19.00	.48447E-03	42.391
20.00	.48349E-03	42.305
21.00	.48257E-03	42.225
22.00	.48172E-03	42.151
23.00	.48094E-03	42.082
24.00	.48023E-03	42.020
25.00	.47958E-03	41.963
26.00	.47899E-03	41.912
27.00	.47847E-03	41.866
28.00	.47800E-03	41.825
29.00	.47760E-03	41.790
30.00	.47724E-03	41.759

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TOTAL GROUNDWATER IMPACT

Time (yr)	Mass (g)	Cumulative Mass (g)
1.00	44.822	44.822
2.00	44.664	89.486
3.00	44.505	133.99

4.00	44.346	178.34
5.00	44.188	222.53
6.00	44.031	266.56
7.00	43.877	310.43
8.00	43.726	354.16
9.00	43.579	397.74
10.00	43.436	441.18
11.00	43.298	484.47
12.00	43.164	527.64
13.00	43.036	570.67
14.00	42.914	613.59
15.00	42.797	656.39
16.00	42.687	699.07
17.00	42.582	741.66
18.00	42.484	784.14
19.00	42.391	826.53
20.00	42.305	868.84
21.00	42.225	911.06
22.00	42.151	953.21
23.00	42.082	995.29
24.00	42.020	1037.3
25.00	41.963	1079.3
26.00	41.912	1121.2
27.00	41.866	1163.1
28.00	41.825	1204.9
29.00	41.790	1246.7
30.00	41.759	1288.4

MIXCELL OUTPUT FILE

PGA VLEACH model

Polygon 92, 9/92 Data, ARM run
(84% at 36 & 52)

Year	Mass (grams)	GW Conc (ug/L)
1	44.822	0.5861
2	44.664	0.8960
3	44.505	1.0589
4	44.346	1.1435
5	44.188	1.1865
6	44.031	1.2073
7	43.877	1.2164
8	43.726	1.2192
9	43.579	1.2188
10	43.436	1.2167
11	43.298	1.2138
12	43.164	1.2105
13	43.036	1.2071
14	42.914	1.2037
15	42.797	1.2003
16	42.687	1.1971
17	42.582	1.1940
18	42.484	1.1911
19	42.391	1.1883
20	42.305	1.1857
21	42.225	1.1833
22	42.151	1.1810
23	42.082	1.1789
24	42.020	1.1770
25	41.963	1.1752
26	41.912	1.1736
27	41.866	1.1721
28	41.825	1.1708
29	41.790	1.1697
30	41.759	1.1687

Polgon 92

Run Number	Soil Vapor Monitoring Piezometer Designation	Modelled Total Soil Concentration (ug/Kg) in each Piezometer	Percentage Reduction from Actual Concentration	Approximate Corresponding Soil Vapor Concentration (Converted from ug/L to ppmV as TCE)	Modelled Maximum Subunit A Impact to Groundwater (ug/L)
1	VS-VP92-17	85.66	0	26.2	
	VS-VP92-28	415.11	0	126.8	7.5590
	VS-VP92-40	531.31	0	162.3	
	VS-VP92-52	1201.00	0	366.8	
2	VS-VP92-17	85.66	0	26.2	
	VS-VP92-28	415.11	0	126.8	4.9175
	VS-VP92-40	345.35	35	105.5	
	VS-VP92-52	780.65	35	238.5	
3	VS-VP92-17	85.66	0	26.2	
	VS-VP92-28	415.11	0	126.8	1.2192
	VS-VP92-40	85.01	84	26.0	
	VS-VP92-52	192.16	84	58.7	

Polygon 27A Soil Gas Data

Total Soil Concentration Calculations from Soil Gas Data
Polygon 27A, July-1993 Phase II Investgation

Sample #	Total Clx Conc (ppbV)	Total Clx Conc (ug/L)*	Total Clx Conc (ug/Kg)**
VS-VP27A-12	170000	890.00	533.11
VS-VP27A-21	290000	1500.00	898.50
VS-VP27A-36	420000	2200.00	1317.80
VS-VP27A-45	440000	2300.00	1377.70
	1320000	6890.00	4127.11

*Laboratory conversion from ppbV to ug/L
**Multiply ug/L concentration by 0.599 L/Kg (calculated Kgt based on revised soil physical data).

1,1-DCE Soil Concentration Calculations from Soil Gas Data
Polygon 27A, July-1993 Phase II Investgation

Sample #	1,1-DCE Conc (ppbV)	1,1-DCE Conc (ug/L)*	1,1-DCE Conc (ug/Kg)**
VS-VP27A-12	0	0.00	0.00
VS-VP27A-21	0	0.00	0.00
VS-VP27A-36	0	0.00	0.00
VS-VP27A-45	0	0.00	0.00
	0.00	0.00	0.00

1,1,1-TCA Soil Concentration Calculations from Soil Gas Data
Polygon 27A, July-1993 Phase II Investgation

Sample #	1,1,1-TCA Conc (ppbV)	1,1,1-TCA Conc (ug/L)*	1,1,1-TCA Conc (ug/Kg)**
VS-VP27A-12	0.0	0.00	0.00
VS-VP27A-21	0.0	0.00	0.00
VS-VP27A-36	0.0	0.00	0.00
VS-VP27A-45	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 27A Soil Gas Data

TCE Soil Concentration Calculations from Soil Gas Data
Polygon 27A, July-1993 Phase II Investgation

Sample #	TCE Conc (ppbV)	TCE Conc (ug/L)*	TCE Conc (ug/Kg)**
VS-VP27A-12	170,000	890.00	533.11
VS-VP27A-21	290,000	1500.00	898.50
VS-VP27A-36	420,000	2200.00	1317.80
VS-VP27A-45	440,000	2300.00	1377.70
	1320000	6890.00	4127.11

PCE Soil Concentration Calculations from Soil Gas Data
Polygon 27A, July-1993 Phase II Investgation

Sample #	PCE Conc (ppbV)	PCE Conc (ug/L)*	PCE Conc (ug/Kg)**
VS-VP27A-12	0.0	0.00	0.00
VS-VP27A-21	0.0	0.00	0.00
VS-VP27A-36	0.0	0.00	0.00
VS-VP27A-45	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 27A Soil Gas Data

Interpolated Concentrations
Polygon 27A, July-1993 Phase II Investgation

Depth (feet)	*Conc. (ug/kg)*
3	133.278
9	399.833
15	654.907
21	898.500
27	1066.220
33	1233.940
39	1337.767
45	1377.70
51	1377.70
57	1377.70
60	1377.70

PGA VLEACH model, Polygon 27A Sept. 21, 1993 Phase II Data

```
  1
    1.0     30.     1.0     10.
  123.6    .473    1100.   .7029
Polygon 84
  50000     1.  .023400   1.64    .381    .255   .00074
     0.     0.     -1.
 60
  1   6   133.28
  7  12   399.83
 13  18   654.91
 19  24   898.50
 25  30  1066.22
 31  36  1233.94
 37  42  1337.77
 43  48  1377.70
 49  54  1377.70
 55  60  1377.70
```

GROUNDWATER IMPACT OF POLYGON 1

Time	Mass per area (g/sq.ft.)	Total Mass (g)
1.00	.32223E-02	161.12
2.00	.32219E-02	161.10
3.00	.32214E-02	161.07
4.00	.32209E-02	161.04
5.00	.32202E-02	161.01
6.00	.32194E-02	160.97
7.00	.32186E-02	160.93
8.00	.32176E-02	160.88
9.00	.32166E-02	160.83
10.00	.32155E-02	160.77
11.00	.32142E-02	160.71
12.00	.32129E-02	160.65
13.00	.32115E-02	160.57
14.00	.32100E-02	160.50
15.00	.32084E-02	160.42
16.00	.32067E-02	160.33
17.00	.32049E-02	160.24
18.00	.32030E-02	160.15
19.00	.32010E-02	160.05
20.00	.31989E-02	159.95
21.00	.31968E-02	159.84
22.00	.31945E-02	159.73
23.00	.31922E-02	159.61
24.00	.31898E-02	159.49
25.00	.31872E-02	159.36
26.00	.31846E-02	159.23
27.00	.31820E-02	159.10
28.00	.31792E-02	158.96
29.00	.31764E-02	158.82
30.00	.31734E-02	158.67

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TOTAL GROUNDWATER IMPACT

Time (yr)	Mass (g)	Cumulative Mass (g)
1.00	161.12	161.12
2.00	161.10	322.21
3.00	161.07	483.28
4.00	161.04	644.33
5.00	161.01	805.34
6.00	160.97	966.31

7.00	160.93	1127.2
8.00	160.88	1288.1
9.00	160.83	1448.9
10.00	160.77	1609.7
11.00	160.71	1770.4
12.00	160.65	1931.1
13.00	160.57	2091.7
14.00	160.50	2252.2
15.00	160.42	2412.6
16.00	160.33	2572.9
17.00	160.24	2733.1
18.00	160.15	2893.3
19.00	160.05	3053.3
20.00	159.95	3213.3
21.00	159.84	3373.1
22.00	159.73	3532.9
23.00	159.61	3692.5
24.00	159.49	3852.0
25.00	159.36	4011.3
26.00	159.23	4170.5
27.00	159.10	4329.6
28.00	158.96	4488.6
29.00	158.82	4647.4
30.00	158.67	4806.1

MIXCELL OUTPUT FILE

PGA VLEACH model　　　　Polygon 27A 9/93

Year	Mass (grams)	GW Conc (ug/L)
1	161.120	3.3701
2	161.100	4.8327
3	161.070	5.4672
4	161.040	5.7420
5	161.010	5.8606
6	160.970	5.9113
7	160.930	5.9325
8	160.880	5.9406
9	160.830	5.9431
10	160.770	5.9429
11	160.710	5.9416
12	160.650	5.9398
13	160.570	5.9373
14	160.500	5.9348
15	160.420	5.9320
16	160.330	5.9289
17	160.240	5.9257
18	160.150	5.9224
19	160.050	5.9189
20	159.950	5.9153
21	159.840	5.9114
22	159.730	5.9074
23	159.610	5.9032
24	159.490	5.8988
25	159.360	5.8942
26	159.230	5.8895
27	159.100	5.8847
28	158.960	5.8797
29	158.820	5.8746
30	158.670	5.8693

Polygon 27A Soil Gas Data

Total Soil Concentration Calculations from Soil Gas Data
Polygon 27A, 7/93 Data, ARM run (15% reduction at 36' & 45')

Sample #	Total Clx Conc (ppbV)	Total Clx Conc (ug/L)*	Total Clx Conc (ug/Kg)**
VS-VP27A-12	170000	890.00	533.11
VS-VP27A-21	290000	1500.00	898.50
VS-VP27A-36	357000	1870.00	1120.13
VS-VP27A-45	374000	1955.00	1171.05
	1191000	6215.00	3722.79

*Laboratory conversion from ppbV to ug/L
**Multiply ug/L concentration by 0.599 L/Kg (calculated Kgt based on revised soil physical data).

1,1-DCE Soil Concentration Calculations from Soil Gas Data
Polygon 27A, 7/93 Data, ARM run (15% reduction at 36' & 45')

Sample #	1,1-DCE Conc (ppbV)	1,1-DCE Conc (ug/L)*	1,1-DCE Conc (ug/Kg)**
VS-VP27A-12	0	0.00	0.00
VS-VP27A-21	0	0.00	0.00
VS-VP27A-36	0	0.00	0.00
VS-VP27A-45	0	0.00	0.00
	0.00	0.00	0.00

1,1,1-TCA Soil Concentration Calculations from Soil Gas Data
Polygon 27A, 7/93 Data, ARM run (15% reduction at 36' & 45')

Sample #	1,1,1-TCA Conc (ppbV)	1,1,1-TCA Conc (ug/L)*	1,1,1-TCA Conc (ug/Kg)**
VS-VP27A-12	0.0	0.00	0.00
VS-VP27A-21	0.0	0.00	0.00
VS-VP27A-36	0.0	0.00	0.00
VS-VP27A-45	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 27A Soil Gas Data

TCE Soil Concentration Calculations from Soil Gas Data
Polygon 27A, 7/93 Data, ARM run (15% reduction at 36' & 45')

Sample #	TCE Conc (ppbV)	TCE Conc (ug/L)*	TCE Conc (ug/Kg)**
VS-VP27A-12	170,000	890.00	533.11
VS-VP27A-21	290,000	1500.00	898.50
VS-VP27A-36	357,000	1870.00	1120.13
VS-VP27A-45	374,000	1955.00	1171.05
	1191000	6215.00	3722.79

PCE Soil Concentration Calculations from Soil Gas Data
Polygon 27A, 7/93 Data, ARM run (15% reduction at 36' & 45')

Sample #	PCE Conc (ppbV)	PCE Conc (ug/L)*	PCE Conc (ug/Kg)**
VS-VP27A-12	0.0	0.00	0.00
VS-VP27A-21	0.0	0.00	0.00
VS-VP27A-36	0.0	0.00	0.00
VS-VP27A-45	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 27A Soil Gas Data

Interpolated Concentrations
Polygon 27A, 7/93 Data, ARM run
(15% reduction at 36' & 45')

Depth (feet)	*Conc. (ug/kg)*
3	133.278
9	399.833
15	654.907
21	898.500
27	987.152
33	1075.804
39	1137.102
45	1171.05
51	1171.05
57	1171.05
60	1171.05

PGA VLEACH model, Polygon 27A, 7/93 Data, ARM run (15% at 36 & 45)

```
  1
   1.0    150.    1.0     10.
  123.6    .473   1100.   .7029
Polygon 27A
  50000     1.  .023400    1.64    .381    .255   .00074
    0.      0.     -1.
 60
  1   6   133.28
  7  12   399.83
 13  18   654.91
 19  24   898.50
 25  30   987.15
 31  36  1075.80
 37  42  1137.10
 43  48  1171.05
 49  54  1171.05
 55  60  1171.05
```

PGA VLEACH model, Polygon 27A, 7/93 Data, ARM run (15% at 36 & 45)

GROUNDWATER IMPACT OF POLYGON 1

Time	Mass per area (g/sq.ft.)	Total Mass (g)
1.00	.27390E-02	136.95
2.00	.27387E-02	136.93
3.00	.27384E-02	136.92
4.00	.27379E-02	136.90
5.00	.27375E-02	136.87
6.00	.27370E-02	136.85
7.00	.27364E-02	136.82
8.00	.27357E-02	136.79
9.00	.27350E-02	136.75
10.00	.27342E-02	136.71
11.00	.27334E-02	136.67
12.00	.27325E-02	136.62
13.00	.27315E-02	136.58
14.00	.27305E-02	136.52
15.00	.27294E-02	136.47
16.00	.27282E-02	136.41
17.00	.27270E-02	136.35
18.00	.27257E-02	136.29
19.00	.27244E-02	136.22
20.00	.27230E-02	136.15
21.00	.27215E-02	136.08
22.00	.27200E-02	136.00
23.00	.27184E-02	135.92
24.00	.27168E-02	135.84
25.00	.27151E-02	135.76
26.00	.27134E-02	135.67
27.00	.27116E-02	135.58
28.00	.27097E-02	135.48
29.00	.27078E-02	135.39
30.00	.27058E-02	135.29
31.00	.27038E-02	135.19
32.00	.27017E-02	135.08
33.00	.26996E-02	134.98
34.00	.26974E-02	134.87
35.00	.26951E-02	134.76
36.00	.26928E-02	134.64
37.00	.26905E-02	134.53
38.00	.26881E-02	134.41
39.00	.26857E-02	134.28
40.00	.26832E-02	134.16

41.00	.26807E-02	134.03
42.00	.26781E-02	133.90
43.00	.26755E-02	133.77
44.00	.26728E-02	133.64
45.00	.26701E-02	133.50
46.00	.26673E-02	133.37
47.00	.26645E-02	133.23
48.00	.26617E-02	133.08
49.00	.26588E-02	132.94
50.00	.26558E-02	132.79
51.00	.26529E-02	132.64
52.00	.26498E-02	132.49
53.00	.26468E-02	132.34
54.00	.26437E-02	132.18
55.00	.26405E-02	132.03
56.00	.26374E-02	131.87
57.00	.26342E-02	131.71
58.00	.26309E-02	131.55
59.00	.26276E-02	131.38
60.00	.26243E-02	131.21
61.00	.26209E-02	131.05
62.00	.26175E-02	130.88
63.00	.26141E-02	130.71
64.00	.26106E-02	130.53
65.00	.26071E-02	130.36
66.00	.26036E-02	130.18
67.00	.26000E-02	130.00
68.00	.25964E-02	129.82
69.00	.25928E-02	129.64
70.00	.25891E-02	129.46
71.00	.25855E-02	129.27
72.00	.25817E-02	129.09
73.00	.25780E-02	128.90
74.00	.25742E-02	128.71
75.00	.25704E-02	128.52
76.00	.25665E-02	128.33
77.00	.25627E-02	128.13
78.00	.25588E-02	127.94
79.00	.25548E-02	127.74
80.00	.25509E-02	127.54
81.00	.25469E-02	127.35
82.00	.25429E-02	127.15
83.00	.25389E-02	126.94
84.00	.25348E-02	126.74
85.00	.25308E-02	126.54

86.00	.25267E-02	126.33
87.00	.25225E-02	126.13
88.00	.25184E-02	125.92
89.00	.25142E-02	125.71
90.00	.25100E-02	125.50
91.00	.25058E-02	125.29
92.00	.25016E-02	125.08
93.00	.24973E-02	124.87
94.00	.24930E-02	124.65
95.00	.24887E-02	124.44
96.00	.24844E-02	124.22
97.00	.24801E-02	124.00
98.00	.24757E-02	123.79
99.00	.24714E-02	123.57
100.00	.24670E-02	123.35
101.00	.24626E-02	123.13
102.00	.24581E-02	122.91
103.00	.24537E-02	122.68
104.00	.24492E-02	122.46
105.00	.24448E-02	122.24
106.00	.24403E-02	122.01
107.00	.24358E-02	121.79
108.00	.24312E-02	121.56
109.00	.24267E-02	121.33
110.00	.24221E-02	121.11
111.00	.24176E-02	120.88
112.00	.24130E-02	120.65
113.00	.24084E-02	120.42
114.00	.24038E-02	120.19
115.00	.23992E-02	119.96
116.00	.23946E-02	119.73
117.00	.23899E-02	119.50
118.00	.23853E-02	119.26
119.00	.23806E-02	119.03
120.00	.23759E-02	118.80
121.00	.23712E-02	118.56
122.00	.23665E-02	118.33
123.00	.23618E-02	118.09
124.00	.23571E-02	117.86
125.00	.23524E-02	117.62
126.00	.23476E-02	117.38
127.00	.23429E-02	117.15
128.00	.23381E-02	116.91
129.00	.23334E-02	116.67
130.00	.23286E-02	116.43

131.00	.23238E-02	116.19
132.00	.23191E-02	115.95
133.00	.23143E-02	115.71
134.00	.23095E-02	115.47
135.00	.23047E-02	115.23
136.00	.22999E-02	114.99
137.00	.22950E-02	114.75
138.00	.22902E-02	114.51
139.00	.22854E-02	114.27
140.00	.22806E-02	114.03
141.00	.22757E-02	113.79
142.00	.22709E-02	113.54
143.00	.22660E-02	113.30
144.00	.22612E-02	113.06
145.00	.22563E-02	112.82
146.00	.22515E-02	112.57
147.00	.22466E-02	112.33
148.00	.22418E-02	112.09
149.00	.22369E-02	111.84
150.00	.22320E-02	111.60

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TOTAL GROUNDWATER IMPACT

Time (yr)	Mass (g)	Cumulative Mass (g)
1.00	136.95	136.95
2.00	136.93	273.88
3.00	136.92	410.80
4.00	136.90	547.70
5.00	136.87	684.57
6.00	136.85	821.42
7.00	136.82	958.24
8.00	136.79	1095.0
9.00	136.75	1231.8
10.00	136.71	1368.5
11.00	136.67	1505.2
12.00	136.62	1641.8
13.00	136.58	1778.4
14.00	136.52	1914.9
15.00	136.47	2051.3
16.00	136.41	2187.8
17.00	136.35	2324.1
18.00	136.29	2460.4
19.00	136.22	2596.6

20.00	136.15	2732.8
21.00	136.08	2868.8
22.00	136.00	3004.8
23.00	135.92	3140.8
24.00	135.84	3276.6
25.00	135.76	3412.4
26.00	135.67	3548.0
27.00	135.58	3683.6
28.00	135.48	3819.1
29.00	135.39	3954.5
30.00	135.29	4089.8
31.00	135.19	4225.0
32.00	135.08	4360.0
33.00	134.98	4495.0
34.00	134.87	4629.9
35.00	134.76	4764.7
36.00	134.64	4899.3
37.00	134.53	5033.8
38.00	134.41	5168.2
39.00	134.28	5302.5
40.00	134.16	5436.7
41.00	134.03	5570.7
42.00	133.90	5704.6
43.00	133.77	5838.4
44.00	133.64	5972.0
45.00	133.50	6105.5
46.00	133.37	6238.9
47.00	133.23	6372.1
48.00	133.08	6505.2
49.00	132.94	6638.1
50.00	132.79	6770.9
51.00	132.64	6903.6
52.00	132.49	7036.1
53.00	132.34	7168.4
54.00	132.18	7300.6
55.00	132.03	7432.6
56.00	131.87	7564.5
57.00	131.71	7696.2
58.00	131.55	7827.7
59.00	131.38	7959.1
60.00	131.21	8090.3
61.00	131.05	8221.4
62.00	130.88	8352.3
63.00	130.71	8483.0
64.00	130.53	8613.5

65.00	130.36	8743.8
66.00	130.18	8874.0
67.00	130.00	9004.0
68.00	129.82	9133.8
69.00	129.64	9263.5
70.00	129.46	9392.9
71.00	129.27	9522.2
72.00	129.09	9651.3
73.00	128.90	9780.2
74.00	128.71	9908.9
75.00	128.52	10037.
76.00	128.33	10166.
77.00	128.13	10294.
78.00	127.94	10422.
79.00	127.74	10550.
80.00	127.54	10677.
81.00	127.35	10804.
82.00	127.15	10932.
83.00	126.94	11059.
84.00	126.74	11185.
85.00	126.54	11312.
86.00	126.33	11438.
87.00	126.13	11564.
88.00	125.92	11690.
89.00	125.71	11816.
90.00	125.50	11941.
91.00	125.29	12067.
92.00	125.08	12192.
93.00	124.87	12317.
94.00	124.65	12441.
95.00	124.44	12566.
96.00	124.22	12690.
97.00	124.00	12814.
98.00	123.79	12938.
99.00	123.57	13061.
100.00	123.35	13185.
101.00	123.13	13308.
102.00	122.91	13431.
103.00	122.68	13553.
104.00	122.46	13676.
105.00	122.24	13798.
106.00	122.01	13920.
107.00	121.79	14042.
108.00	121.56	14163.
109.00	121.33	14285.

110.00	121.11	14406.
111.00	120.88	14527.
112.00	120.65	14647.
113.00	120.42	14768.
114.00	120.19	14888.
115.00	119.96	15008.
116.00	119.73	15128.
117.00	119.50	15247.
118.00	119.26	15366.
119.00	119.03	15486.
120.00	118.80	15604.
121.00	118.56	15723.
122.00	118.33	15841.
123.00	118.09	15959.
124.00	117.86	16077.
125.00	117.62	16195.
126.00	117.38	16312.
127.00	117.15	16429.
128.00	116.91	16546.
129.00	116.67	16663.
130.00	116.43	16779.
131.00	116.19	16895.
132.00	115.95	17011.
133.00	115.71	17127.
134.00	115.47	17243.
135.00	115.23	17358.
136.00	114.99	17473.
137.00	114.75	17588.
138.00	114.51	17702.
139.00	114.27	17816.
140.00	114.03	17930.
141.00	113.79	18044.
142.00	113.54	18158.
143.00	113.30	18271.
144.00	113.06	18384.
145.00	112.82	18497.
146.00	112.57	18610.
147.00	112.33	18722.
148.00	112.09	18834.
149.00	111.84	18946.
150.00	111.60	19057.

MIXCELL OUTPUT FILE

PGA VLEACH model

Polygon 27A, 7/93 Data, ARM run
(15% at 36 & 45)

Year	Mass (grams)	GW Conc (ug/L)
1	136.950	2.8645
2	136.930	4.1077
3	136.920	4.6472
4	136.900	4.8811
5	136.870	4.9820
6	136.850	5.0253
7	136.820	5.0435
8	136.790	5.0508
9	136.750	5.0531
10	136.710	5.0533
11	136.670	5.0525
12	136.620	5.0512
13	136.580	5.0497
14	136.520	5.0479
15	136.470	5.0460
16	136.410	5.0439
17	136.350	5.0418
18	136.290	5.0396
19	136.220	5.0372
20	136.150	5.0347
21	136.080	5.0321
22	136.000	5.0293
23	135.920	5.0265
24	135.840	5.0235
25	135.760	5.0206
26	135.670	5.0174
27	135.580	5.0142
28	135.480	5.0107
29	135.390	5.0073
30	135.290	5.0037
31	135.190	5.0000
32	135.080	4.9962
33	134.980	4.9924
34	134.870	4.9885
35	134.760	4.9844
36	134.640	4.9802
37	134.530	4.9760

38	134.410	4.9717
39	134.280	4.9671
40	134.160	4.9626
41	134.030	4.9580
42	133.900	4.9532
43	133.770	4.9484
44	133.640	4.9436
45	133.500	4.9386
46	133.370	4.9337
47	133.230	4.9287
48	133.080	4.9234
49	132.940	4.9181
50	132.790	4.9127
51	132.640	4.9072
52	132.490	4.9017
53	132.340	4.8962
54	132.180	4.8904
55	132.030	4.8848
56	131.870	4.8790
57	131.710	4.8731
58	131.550	4.8672
59	131.380	4.8611
60	131.210	4.8549
61	131.050	4.8489
62	130.880	4.8427
63	130.710	4.8364
64	130.530	4.8300
65	130.360	4.8236
66	130.180	4.8171
67	130.000	4.8105
68	129.820	4.8038
69	129.640	4.7972
70	129.460	4.7905
71	129.270	4.7837
72	129.090	4.7769
73	128.900	4.7700
74	128.710	4.7631
75	128.520	4.7561
76	128.330	4.7491
77	128.130	4.7418
78	127.940	4.7347
79	127.740	4.7274
80	127.540	4.7201
81	127.350	4.7129
82	127.150	4.7057

83	126.940	4.6981
84	126.740	4.6906
85	126.540	4.6832
86	126.330	4.6756
87	126.130	4.6681
88	125.920	4.6605
89	125.710	4.6527
90	125.500	4.6450
91	125.290	4.6373
92	125.080	4.6295
93	124.870	4.6217
94	124.650	4.6138
95	124.440	4.6059
96	124.220	4.5979
97	124.000	4.5898
98	123.790	4.5819
99	123.570	4.5739
%100	123.350	4.5658
%101	123.130	4.5577
%102	122.910	4.5496
%103	122.680	4.5412
%104	122.460	4.5330
%105	122.240	4.5248
%106	122.010	4.5165
%107	121.790	4.5082
%108	121.560	4.4999
%109	121.330	4.4914
%110	121.110	4.4831
%111	120.880	4.4747
%112	120.650	4.4663
%113	120.420	4.4578
%114	120.190	4.4493
%115	119.960	4.4408
%116	119.730	4.4323
%117	119.500	4.4238
%118	119.260	4.4151
%119	119.030	4.4065
%120	118.800	4.3980
%121	118.560	4.3892
%122	118.330	4.3806
%123	118.090	4.3719
%124	117.860	4.3633
%125	117.620	4.3545
%126	117.380	4.3457
%127	117.150	4.3370

%128	116.910	4.3283
%129	116.670	4.3194
%130	116.430	4.3106
%131	116.190	4.3017
%132	115.950	4.2929
%133	115.710	4.2840
%134	115.470	4.2751
%135	115.230	4.2662
%136	114.990	4.2574
%137	114.750	4.2485
%138	114.510	4.2396
%139	114.270	4.2308
%140	114.030	4.2219
%141	113.790	4.2130
%142	113.540	4.2039
%143	113.300	4.1950
%144	113.060	4.1861
%145	112.820	4.1772
%146	112.570	4.1681
%147	112.330	4.1591
%148	112.090	4.1502
%149	111.840	4.1411
%150	111.600	4.1321

Polygon 27A Soil Gas Data

Total Soil Concentration Calculations from Soil Gas Data
Polygon 27A, 7/93 Data, ARM run (85% reduction at 36' & 45', 25% at 12' & 21')

Sample #	Total Clx Conc (ppbV)	Total Clx Conc (ug/L)*	Total Clx Conc (ug/Kg)**
VS-VP27A-12	127500	667.50	399.83
VS-VP27A-21	217500	1125.00	673.88
VS-VP27A-36	63000	330.00	197.67
VS-VP27A-45	66000	345.00	206.66
	474000	2467.50	1478.03

*Laboratory conversion from ppbV to ug/L
**Multiply ug/L concentration by 0.599 L/Kg (calculated Kgt based on revised soil physical data).

1,1-DCE Soil Concentration Calculations from Soil Gas Data
Polygon 27A, 7/93 Data, ARM run (85% reduction at 36' & 45', 25% at 12' & 21')

Sample #	1,1-DCE Conc (ppbV)	1,1-DCE Conc (ug/L)*	1,1-DCE Conc (ug/Kg)**
VS-VP27A-12	0	0.00	0.00
VS-VP27A-21	0	0.00	0.00
VS-VP27A-36	0	0.00	0.00
VS-VP27A-45	0	0.00	0.00
	0.00	0.00	0.00

1,1,1-TCA Soil Concentration Calculations from Soil Gas Data
Polygon 27A, 7/93 Data, ARM run (85% reduction at 36' & 45', 25% at 12' & 21')

Sample #	1,1,1-TCA Conc (ppbV)	1,1,1-TCA Conc (ug/L)*	1,1,1-TCA Conc (ug/Kg)**
VS-VP27A-12	0.0	0.00	0.00
VS-VP27A-21	0.0	0.00	0.00
VS-VP27A-36	0.0	0.00	0.00
VS-VP27A-45	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 27A Soil Gas Data

TCE Soil Concentration Calculations from Soil Gas Data
Polygon 27A, 7/93 Data, ARM run (85% reduction at 36' & 45', 25% at 12' & 21')

Sample #	TCE Conc (ppbV)	TCE Conc (ug/L)*	TCE Conc (ug/Kg)**
VS-VP27A-12	127,500	667.50	399.83
VS-VP27A-21	217,500	1125.00	673.88
VS-VP27A-36	63,000	330.00	197.67
VS-VP27A-45	66,000	345.00	206.66
	474000	2467.50	1478.03

PCE Soil Concentration Calculations from Soil Gas Data
Polygon 27A, 7/93 Data, ARM run (85% reduction at 36' & 45', 25% at 12' & 21')

Sample #	PCE Conc (ppbV)	PCE Conc (ug/L)*	PCE Conc (ug/Kg)**
VS-VP27A-12	0.0	0.00	0.00
VS-VP27A-21	0.0	0.00	0.00
VS-VP27A-36	0.0	0.00	0.00
VS-VP27A-45	0.0	0.00	0.00
	0.0	0.00	0.00

Polygon 27A Soil Gas Data

Interpolated Concentrations
Polygon 27A, 7/93 Data, ARM run
(85% reduction at 36' & 45', 25% at 12' & 21')

Depth (feet)	*Conc. (ug/kg)*
3	99.958
9	299.874
15	491.180
21	673.875
27	483.393
33	292.911
39	200.665
45	206.66
51	206.66
57	206.66
60	206.66

PGA VLEACH model, Polygon 27A, 7/93 Data, ARM run (85% at 36 & 45, 25% at 12 & 21)

```
 1
   1.0    150.    1.0    10.
  123.6    .473   1100.   .7029
Polygon 27A
  50000     1.  .023400    1.64    .381    .255   .00074
    0.     0.    -1.
 60
 1   6   99.96
 7  12   299.87
13  18   491.18
19  24   673.88
25  30   483.40
31  36   292.91
37  42   200.67
43  48   206.66
49  54   206.66
55  60   206.66
```

PGA VLEACH model, Polygon 27A, 7/93 Data, ARM run (85% at 36 & 45, 25% at 12 & 21)

GROUNDWATER IMPACT OF POLYGON 1

Time	Mass per area (g/sq.ft.)	Total Mass (g)
1.00	.48336E-03	24.168
2.00	.48352E-03	24.176
3.00	.48372E-03	24.186
4.00	.48397E-03	24.199
5.00	.48427E-03	24.214
6.00	.48463E-03	24.231
7.00	.48503E-03	24.252
8.00	.48550E-03	24.275
9.00	.48602E-03	24.301
10.00	.48659E-03	24.330
11.00	.48722E-03	24.361
12.00	.48791E-03	24.396
13.00	.48866E-03	24.433
14.00	.48946E-03	24.473
15.00	.49032E-03	24.516
16.00	.49124E-03	24.562
17.00	.49221E-03	24.611
18.00	.49324E-03	24.662
19.00	.49433E-03	24.716
20.00	.49546E-03	24.773
21.00	.49665E-03	24.833
22.00	.49789E-03	24.895
23.00	.49918E-03	24.959
24.00	.50052E-03	25.026
25.00	.50191E-03	25.095
26.00	.50334E-03	25.167
27.00	.50481E-03	25.240
28.00	.50633E-03	25.316
29.00	.50788E-03	25.394
30.00	.50948E-03	25.474
31.00	.51111E-03	25.555
32.00	.51277E-03	25.639
33.00	.51447E-03	25.724
34.00	.51620E-03	25.810
35.00	.51796E-03	25.898
36.00	.51974E-03	25.987
37.00	.52156E-03	26.078
38.00	.52339E-03	26.170
39.00	.52525E-03	26.262
40.00	.52712E-03	26.356

41.00	.52902E-03	26.451
42.00	.53093E-03	26.546
43.00	.53285E-03	26.642
44.00	.53479E-03	26.739
45.00	.53673E-03	26.837
46.00	.53869E-03	26.934
47.00	.54065E-03	27.033
48.00	.54262E-03	27.131
49.00	.54459E-03	27.230
50.00	.54657E-03	27.328
51.00	.54855E-03	27.427
52.00	.55052E-03	27.526
53.00	.55249E-03	27.625
54.00	.55446E-03	27.723
55.00	.55643E-03	27.821
56.00	.55839E-03	27.919
57.00	.56034E-03	28.017
58.00	.56228E-03	28.114
59.00	.56422E-03	28.211
60.00	.56614E-03	28.307
61.00	.56805E-03	28.402
62.00	.56995E-03	28.497
63.00	.57183E-03	28.591
64.00	.57370E-03	28.685
65.00	.57555E-03	28.777
66.00	.57738E-03	28.869
67.00	.57920E-03	28.960
68.00	.58099E-03	29.050
69.00	.58277E-03	29.138
70.00	.58453E-03	29.226
71.00	.58626E-03	29.313
72.00	.58798E-03	29.399
73.00	.58967E-03	29.483
74.00	.59134E-03	29.567
75.00	.59298E-03	29.649
76.00	.59460E-03	29.730
77.00	.59620E-03	29.810
78.00	.59777E-03	29.889
79.00	.59932E-03	29.966
80.00	.60084E-03	30.042
81.00	.60233E-03	30.117
82.00	.60380E-03	30.190
83.00	.60524E-03	30.262
84.00	.60665E-03	30.333
85.00	.60804E-03	30.402

86.00	.60940E-03	30.470
87.00	.61073E-03	30.536
88.00	.61203E-03	30.601
89.00	.61330E-03	30.665
90.00	.61454E-03	30.727
91.00	.61576E-03	30.788
92.00	.61695E-03	30.847
93.00	.61811E-03	30.905
94.00	.61924E-03	30.962
95.00	.62034E-03	31.017
96.00	.62141E-03	31.070
97.00	.62245E-03	31.123
98.00	.62347E-03	31.173
99.00	.62445E-03	31.223
100.00	.62541E-03	31.270
101.00	.62633E-03	31.317
102.00	.62723E-03	31.362
103.00	.62810E-03	31.405
104.00	.62894E-03	31.447
105.00	.62975E-03	31.488
106.00	.63054E-03	31.527
107.00	.63129E-03	31.565
108.00	.63202E-03	31.601
109.00	.63272E-03	31.636
110.00	.63339E-03	31.670
111.00	.63403E-03	31.702
112.00	.63465E-03	31.732
113.00	.63524E-03	31.762
114.00	.63580E-03	31.790
115.00	.63633E-03	31.817
116.00	.63684E-03	31.842
117.00	.63732E-03	31.866
118.00	.63777E-03	31.889
119.00	.63820E-03	31.910
120.00	.63860E-03	31.930
121.00	.63898E-03	31.949
122.00	.63933E-03	31.966
123.00	.63965E-03	31.983
124.00	.63995E-03	31.998
125.00	.64023E-03	32.011
126.00	.64048E-03	32.024
127.00	.64070E-03	32.035
128.00	.64090E-03	32.045
129.00	.64108E-03	32.054
130.00	.64123E-03	32.062

131.00	.64136E-03	32.068
132.00	.64147E-03	32.073
133.00	.64155E-03	32.078
134.00	.64161E-03	32.081
135.00	.64165E-03	32.083
136.00	.64167E-03	32.084
137.00	.64166E-03	32.083
138.00	.64164E-03	32.082
139.00	.64159E-03	32.079
140.00	.64152E-03	32.076
141.00	.64143E-03	32.071
142.00	.64132E-03	32.066
143.00	.64119E-03	32.059
144.00	.64103E-03	32.052
145.00	.64086E-03	32.043
146.00	.64067E-03	32.034
147.00	.64046E-03	32.023
148.00	.64023E-03	32.012
149.00	.63998E-03	31.999
150.00	.63972E-03	31.986

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TOTAL GROUNDWATER IMPACT

Time (yr)	Mass (g)	Cumulative Mass (g)
1.00	24.168	24.168
2.00	24.176	48.344
3.00	24.186	72.530
4.00	24.199	96.728
5.00	24.214	120.94
6.00	24.231	145.17
7.00	24.252	169.43
8.00	24.275	193.70
9.00	24.301	218.00
10.00	24.330	242.33
11.00	24.361	266.69
12.00	24.396	291.09
13.00	24.433	315.52
14.00	24.473	339.99
15.00	24.516	364.51
16.00	24.562	389.07
17.00	24.611	413.68
18.00	24.662	438.34
19.00	24.716	463.06

20.00	24.773	487.83
21.00	24.833	512.67
22.00	24.895	537.56
23.00	24.959	562.52
24.00	25.026	587.55
25.00	25.095	612.64
26.00	25.167	637.81
27.00	25.240	663.05
28.00	25.316	688.36
29.00	25.394	713.76
30.00	25.474	739.23
31.00	25.555	764.79
32.00	25.639	790.43
33.00	25.724	816.15
34.00	25.810	841.96
35.00	25.898	867.86
36.00	25.987	893.84
37.00	26.078	919.92
38.00	26.170	946.09
39.00	26.262	972.35
40.00	26.356	998.71
41.00	26.451	1025.2
42.00	26.546	1051.7
43.00	26.642	1078.4
44.00	26.739	1105.1
45.00	26.837	1131.9
46.00	26.934	1158.9
47.00	27.033	1185.9
48.00	27.131	1213.0
49.00	27.230	1240.3
50.00	27.328	1267.6
51.00	27.427	1295.0
52.00	27.526	1322.5
53.00	27.625	1350.2
54.00	27.723	1377.9
55.00	27.821	1405.7
56.00	27.919	1433.6
57.00	28.017	1461.6
58.00	28.114	1489.8
59.00	28.211	1518.0
60.00	28.307	1546.3
61.00	28.402	1574.7
62.00	28.497	1603.2
63.00	28.591	1631.8
64.00	28.685	1660.4

65.00	28.777	1689.2
66.00	28.869	1718.1
67.00	28.960	1747.1
68.00	29.050	1776.1
69.00	29.138	1805.2
70.00	29.226	1834.5
71.00	29.313	1863.8
72.00	29.399	1893.2
73.00	29.483	1922.7
74.00	29.567	1952.2
75.00	29.649	1981.9
76.00	29.730	2011.6
77.00	29.810	2041.4
78.00	29.889	2071.3
79.00	29.966	2101.3
80.00	30.042	2131.3
81.00	30.117	2161.4
82.00	30.190	2191.6
83.00	30.262	2221.9
84.00	30.333	2252.2
85.00	30.402	2282.6
86.00	30.470	2313.1
87.00	30.536	2343.6
88.00	30.601	2374.2
89.00	30.665	2404.9
90.00	30.727	2435.6
91.00	30.788	2466.4
92.00	30.847	2497.3
93.00	30.905	2528.2
94.00	30.962	2559.1
95.00	31.017	2590.1
96.00	31.070	2621.2
97.00	31.123	2652.3
98.00	31.173	2683.5
99.00	31.223	2714.7
100.00	31.270	2746.0
101.00	31.317	2777.3
102.00	31.362	2808.7
103.00	31.405	2840.1
104.00	31.447	2871.5
105.00	31.488	2903.0
106.00	31.527	2934.5
107.00	31.565	2966.1
108.00	31.601	2997.7
109.00	31.636	3029.3

110.00	31.670	3061.0
111.00	31.702	3092.7
112.00	31.732	3124.4
113.00	31.762	3156.2
114.00	31.790	3188.0
115.00	31.817	3219.8
116.00	31.842	3251.7
117.00	31.866	3283.5
118.00	31.889	3315.4
119.00	31.910	3347.3
120.00	31.930	3379.3
121.00	31.949	3411.2
122.00	31.966	3443.2
123.00	31.983	3475.2
124.00	31.998	3507.2
125.00	32.011	3539.2
126.00	32.024	3571.2
127.00	32.035	3603.2
128.00	32.045	3635.3
129.00	32.054	3667.3
130.00	32.062	3699.4
131.00	32.068	3731.5
132.00	32.073	3763.5
133.00	32.078	3795.6
134.00	32.081	3827.7
135.00	32.083	3859.8
136.00	32.084	3891.8
137.00	32.083	3923.9
138.00	32.082	3956.0
139.00	32.079	3988.1
140.00	32.076	4020.2
141.00	32.071	4052.2
142.00	32.066	4084.3
143.00	32.059	4116.4
144.00	32.052	4148.4
145.00	32.043	4180.5
146.00	32.034	4212.5
147.00	32.023	4244.5
148.00	32.012	4276.5
149.00	31.999	4308.5
150.00	31.986	4340.5

MIXCELL OUTPUT FILE

PGA VLEACH model

Polygon 27A, 7/93 Data, ARM run
(85% at 36 & 45, 25% at 12 & 21)

Year	Mass (grams)	GW Conc (ug/L)
1	24.168	0.5055
2	24.176	0.7251
3	24.186	0.8207
4	24.199	0.8625
5	24.214	0.8809
6	24.231	0.8893
7	24.252	0.8933
8	24.275	0.8956
9	24.301	0.8971
10	24.330	0.8984
11	24.361	0.8996
12	24.396	0.9008
13	24.433	0.9021
14	24.473	0.9036
15	24.516	0.9051
16	24.562	0.9067
17	24.611	0.9084
18	24.662	0.9102
19	24.716	0.9121
20	24.773	0.9142
21	24.833	0.9163
22	24.895	0.9185
23	24.959	0.9208
24	25.026	0.9232
25	25.095	0.9257
26	25.167	0.9283
27	25.240	0.9310
28	25.316	0.9337
29	25.394	0.9365
30	25.474	0.9394
31	25.555	0.9424
32	25.639	0.9454
33	25.724	0.9485
34	25.810	0.9516
35	25.898	0.9549
36	25.987	0.9581
37	26.078	0.9614

38	26.170	0.9648
39	26.262	0.9682
40	26.356	0.9716
41	26.451	0.9751
42	26.546	0.9786
43	26.642	0.9821
44	26.739	0.9857
45	26.837	0.9893
46	26.934	0.9929
47	27.033	0.9965
48	27.131	1.0001
49	27.230	1.0038
50	27.328	1.0074
51	27.427	1.0110
52	27.526	1.0147
53	27.625	1.0183
54	27.723	1.0220
55	27.821	1.0256
56	27.919	1.0292
57	28.017	1.0329
58	28.114	1.0365
59	28.211	1.0401
60	28.307	1.0436
61	28.402	1.0472
62	28.497	1.0507
63	28.591	1.0542
64	28.685	1.0577
65	28.777	1.0611
66	28.869	1.0645
67	28.960	1.0679
68	29.050	1.0713
69	29.138	1.0745
70	29.226	1.0778
71	29.313	1.0811
72	29.399	1.0843
73	29.483	1.0874
74	29.567	1.0905
75	29.649	1.0936
76	29.730	1.0966
77	29.810	1.0996
78	29.889	1.1026
79	29.966	1.1055
80	30.042	1.1083
81	30.117	1.1111
82	30.190	1.1139

83	30.262	1.1166
84	30.333	1.1192
85	30.402	1.1218
86	30.470	1.1244
87	30.536	1.1268
88	30.601	1.1293
89	30.665	1.1317
90	30.727	1.1340
91	30.788	1.1363
92	30.847	1.1385
93	30.905	1.1407
94	30.962	1.1429
95	31.017	1.1449
96	31.070	1.1469
97	31.123	1.1489
98	31.173	1.1508
99	31.223	1.1527
%100	31.270	1.1545
%101	31.317	1.1563
%102	31.362	1.1580
%103	31.405	1.1596
%104	31.447	1.1612
%105	31.488	1.1628
%106	31.527	1.1642
%107	31.565	1.1657
%108	31.601	1.1671
%109	31.636	1.1684
%110	31.670	1.1697
%111	31.702	1.1709
%112	31.732	1.1721
%113	31.762	1.1732
%114	31.790	1.1743
%115	31.817	1.1753
%116	31.842	1.1763
%117	31.866	1.1772
%118	31.889	1.1781
%119	31.910	1.1789
%120	31.930	1.1797
%121	31.949	1.1804
%122	31.966	1.1811
%123	31.983	1.1817
%124	31.998	1.1823
%125	32.011	1.1829
%126	32.024	1.1834
%127	32.035	1.1838

%128	32.045	1.1842
%129	32.054	1.1846
%130	32.062	1.1849
%131	32.068	1.1852
%132	32.073	1.1854
%133	32.078	1.1856
%134	32.081	1.1857
%135	32.083	1.1859
%136	32.084	1.1859
%137	32.083	1.1859
%138	32.082	1.1859
%139	32.079	1.1858
%140	32.076	1.1858
%141	32.071	1.1856
%142	32.066	1.1854
%143	32.059	1.1852
%144	32.052	1.1850
%145	32.043	1.1847
%146	32.034	1.1844
%147	32.023	1.1840
%148	32.012	1.1836
%149	31.999	1.1832
%150	31.986	1.1827

Polgon 27A

Run Number	Soil Vapor Monitoring Piezometer Designation	Modelled Total Soil Concentration (ug/Kg) In each Piezometer	Percentage Reduction from Actual Concentration	Approximate Corresponding Soil Vapor Concentration (Converted from ug/L to ppmV as TCE)	Modelled Maximum Subunit A Impact to Groundwater (ug/L)
1	VS-VP27A-12	533.11	0	162.8	
	VS-VP27A-21	898.50	0	274.5	5.9431
	VS-VP27A-36	1317.80	0	402.5	
	VS-VP27A-45	1377.70	0	420.8	
2	VS-VP27A-12	533.10	0	162.8	
	VS-VP27A-21	898.50	0	274.5	5.0533
	VS-VP27A-36	1120.13	15	342.1	
	VS-VP27A-45	1171.05	15	357.7	
3	VS-VP27A-12	399.83	25	122.1	
	VS-VP27A-21	673.88	25	205.8	1.1859
	VS-VP27A-36	197.67	85	60.4	
	VS-VP27A-45	206.66	85	63.1	